THURSDAY, AUGUST 7, 1913.

MANIHOT RUBBER.

Der Manihot-Kautschuk. Seine Kultur, Gewinnung und Präparation. By Prof. A. Zimmermann. Pp. ix + 342. (Jena: Gustav Fischer, 1913.) Price 9 marks.

THE subject of rubber cultivation is one which has received much attention during recent years. Hitherto the Middle East has confined its attention almost entirely to the cultivation of *Hevea brasiliensis*, rather than that of Manihot, which is the subject of Dr. Zimmermann's book. Manihot is not regarded in the Middle East as being so profitable to cultivate as *Hevea brasiliensis*, but it certainly takes a very high place among the arborescent forms of rubber-yielding plants in virtue of its rapid rate of growth, its hardy characteristics, and quality of rubber.

Four species are dealt with by the author, viz., *Manihot Glaziovii*, Müll. Arg.; *M. dichotoma*, Ule; *M. piauhyensis*, Ule; *M. heptaphylla*. The first species is that which has been most largely distributed throughout the tropics, and is the source of "Ceara" rubber of commerce. The other species have only recently come into prominence, mainly as the result of the work of Dr. Ule in tropical America.

A full description is given in chapter ii. of these species and their natural habitats. The cultivation in different countries, the variability of the plant, its anatomy, morphology, and diseases of various parts are also dealt with. An interesting diagram is shown, giving a good idea of the distribution of the bands of laticiferous tissue. A transverse section through the cortex and bark of *Manihot Glaziovii* shows the connected tangential bands of laticifers near the cambium being broken up as one passes outwards; in fact, from this transverse section one would be inclined to infer that if the tapping instrument was pressed deep enough it would, on every occasion (except where it touched a medullary ray), puncture a laticiferous vessel, and thus give rise to an exudation of latex.

An instructive chapter deals with the various methods of tapping, and a series of diagrams showing the half spiral, half herring-bone, full herring-bone, full spiral, and "V" tapping is given. Some of the tapping implements depicted are somewhat out of date, but will prove of interest to the general reader. Various systems of tapping, including pricking and vertical incisions, are very well illustrated.

The last six chapters of the book (xvi. to xxi.) deal with the general research which has been done in connection with rubber, and go somewhat deeply into the problem of tackiness, colour, and preparation of rubber. Even an account is given of the proceeds and revenue from plantations, and of the further uses of rubber trees. The book therefore covers a very wide field, and should prove of great interest to all connected with the rubber industry. Dr. Zimmermann's book will probably stand out for some time as one of the best on species of Manihot.

H. W.

COMPARATIVE ANATOMY.

Vorlesungen über vergleichende Anatomie. By Prof. Otto Bütschli. 2. Lieferung: Allgemeine Körper- und Bewegungsmuskulatur; Elektrische Organe und Nervensystem. Pp. iv + 401—644. (Leipzig: W. Engelmann, 1912.) Price 9 marks.

THE first volume of these lectures was reviewed in NATURE in July, 1911, and attention was directed to the comprehensive scope of the work, the lucidity of exposition, and the excellence of the simple semi-diagrammatic illustrations. These qualities are fully maintained in the second volume, which deals with the muscular and nervous systems.

In a work covering such an extensive field of investigation it is quite impossible for one man to acquire a first-hand knowledge of all the material of which he treats, or even to do more than sample the voluminous flood of literature dealing with all the subjects discussed in such lectures as these. In such circumstances it would be easy for the specialist in any one branch of research to criticise the facts and inferences, and in many cases also the choice of interpretations borrowed from other writers. But such defects, which are, of course, inevitable, are more than compensated by the broad, well-balanced, and consistent view the general reader obtains when one competent writer surveys the whole subject.

In recent years intensive specialisation has made most of our text-books a badly-fitted patchwork of the scraps of knowledge which a host of authors has garnered, each in his own patch of cultivation; and most students and teachers have become only too familiar with the ill-jointed and distorted ideas such books convey. In studying such lectures as Bütschli's, even if one admits that the detailed information may not be as accurate as can be obtained in the patchwork type of book by several authors, the reader gets a truer perspective, and sees the facts blended into a picture

which, on the whole, is a closer representation of the facts of nature than a collection of more accurate scraps of knowledge not properly assimilated one to the other can possibly be. Those biologists who find it a matter of the utmost difficulty to keep abreast of the growth of knowledge in one small corner of the vast field of comparative anatomy can alone appreciate the magnitude of the task Prof. Bütschli has accomplished in these volumes. For a man who has built up a deservedly great reputation by original investigation in the domain of protozoology to write the best comparative anatomy of the Vertebrates is surely an achievement that is not likely to be repeated. G. E. S.

RESUSCITATION.

Resuscitation from Electric Shock, Traumatic Shock, Drowning, Asphyxiation from any cause by means of Artificial Respiration by the Prone Pressure (Schaefer) Method. By Dr. C. A. Lauffer. Pp. v+47. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1913.) Price 2*s.* net.

IN this little book of forty-seven pages Dr. Lauffer, the medical director of the Westinghouse Electric and Manufacturing Company, East Pittsburg, deals with the subject of artificial respiration as applied to resuscitation in electric shock. Dr. Lauffer is an enthusiastic advocate of the prone pressure (Schaefer) method of resuscitation, and his enthusiasm appears to be based upon considerable experience. He narrates several cases which have come under his immediate notice in which it has been successfully employed: one of concussion of the brain, with unconsciousness and failure both of heart and respiration, requiring an hour's application of the method; two severe cases of electric shock; one of suffocation from smoke, in which life appeared to be extinct; one of an injury to the head, in which respiration was completely arrested and the patient would have died but for the prompt assistance of artificial respiration on the part of one of the men whom he had instructed who happened to be present; and one of drowning. In addition to these cases, he states that he knows a man who has resuscitated six victims of electric shock, all of which cases would have been fatal but for his prompt and efficient efforts at artificial respiration. The author adds, "This man is an enthusiastic advocate of the prone pressure method."

Dr. Lauffer does not, it will be seen, confine himself to those cases in which he is more immediately interested, but has carried on his observations on cases of asphyxia from whatever cause. He points out the various circumstances in which artificial respiration may be necessary, including asphyxia arising from poisoning from carbon monoxide, ammonia fumes, gasoline fumes, sewer gas, suffocation by smoke, inhalation of confined air, inhalations of chloroform and ether, overdoses of laudanum, shock from a heavy blow on the abdomen, and apparent death from drowning. He explains the process of respiration, and gives a clear account of the manner in which artificial respiration should be performed. He especially emphasises the fact that by the prone pressure method resuscitation can easily be carried out by a single individual and without the aid of any extraneous apparatus; even if the operator be a mere boy and the victim an adult, the boy can utilise more than 80 per cent. of his weight by raising his knees from the ground and supporting himself entirely on his toes and the heels of his hands, the latter being properly placed over the floating ribs of the patient. He might perhaps have added that if the boy were to kneel directly upon the back of the patient, an even larger proportion of the operator's weight might be utilised.

Dr. Lauffer has never seen a case of fracture of the ribs or any damage to internal organs arise from the prone pressure method. He considers that the teaching of the subject should be made a part of every gymnastic course, especially in college and Y.M.C.A. gymnasiums and in Boy Scout organisations (which we believe is already the case in this country); he states that it is employed in the United States Army as part of the setting-up exercises.

The author further deals with the question of supplementary assistance which might be rendered if there is any second person to assist, but rightly points out that nothing must be allowed to interfere with the immediate application of artificial respiration, nor should this be desisted from nor the patient permitted to get up until his breathing has become regular. Dealing with the question of mechanical assistance, whilst not averse to the employment of any such assistance if it is immediately available, he points out that extravagant claims are made for various mechanical devices, and that, since such devices may be too remote, or when procured may be out of order, he concludes that there is nothing so dependable as the hands of a man's friends, and that no reliance can be placed on any outfit that cannot be carried with every electrical workman and which is not instantly available.

We commend Dr. Lauffer's little book to all who are interested in the subject.

MATHEMATICAL TEXT-BOOKS.

(1) *A School Algebra.* By F. O. Lane and J. A. C. Lane. Pp. viii + 333. (London: Edward Arnold, n.d.) Price 3*s.* 6*d.*

(2) *A Treatise on Hydromechanics.* Part ii. Hydrodynamics. By A. S. Ramsey. Pp. xiii + 360. (London: G. Bell and Sons., Ltd., 1913.)

(3) *Les Appareils d'Intégration.* By H. de Morin. Pp. 208. (Paris: Gauthier-Villars, 1913.) Price 5 francs.

(4) *Einführung in die höhere Mathematik für Naturforscher und Aerzte.* By Dr. J. Salpeter. Pp. xii + 336. (Jena: Gustav Fischer, 1913.) Price 12 marks.

(5) *Elements of the Precision of Measurements and Graphical Methods.* By Prof. H. M. Goodwin. Pp. 104. (London: Hill Publishing Co., Ltd.; New York: McGraw-Hill Book Co., 1913.)

(6) *Matrices and Determinoids.* By Prof. C. E. Cullis. Vol. i. Pp. xii + 430. (Cambridge University Press, 1913.) Price 21*s.* net.

(1) MESSRS. LANE'S "Algebra" looks as if it would prove a useful school-book. In dealing with the binomial and exponential series the authors state certain properties, with the explicit warning that they are not proving them. This is as it should be; but the chapter on exponentials and logarithms is not so clear as it might be; in particular, Arts. 135-7 would be better if arranged in the reverse order. In the earlier pages we have the old fallacious and meaningless statement: "to multiply a number a by a second number b, we do to a what is done to the unit to obtain b." It would be much better to give the rule of signs as a rule pure and simple, and then to show by cases of $(a-b)(c-d)$ that it does actually work out in practice. There are hundreds of examples—some, alas, of a highly artificial character; for instance, "If the hypotenuse of a right-angled triangle is x, and the other sides are y and z units of length, show that

$$1/\log_{x+z} y + 1/\log_{x-z} y = 2,"$$

or, again:

"Multiply $3\sqrt{xy^3} - xy + 2\sqrt{y^5x^{-1}}$ by $\sqrt{x^3y} - 2\sqrt{xy^3}$."

The most interesting chapters in the book are those on simultaneous equations, which are illustrated by appropriate graphs.

(2) Mr. Ramsey's "Hydrodynamics" is a treatise specially suited for university candidates, and as such may be highly praised for its clearness, elegance, and helpfulness. The chapter on discontinuous motion is exceptionally good, the cases discussed being worked out in unusual detail. The book includes a chapter on vibrations of strings, and one on sound waves; there is a large number of excellent examples, with their sources indicated; and sufficient references are given to original memoirs. As a text-book for capable students, Mr. Ramsey's work will be very hard to improve upon, and is certain to have a favourable reception.

(3) Mr. de Morin describes various kinds of planimeters, integrometers, integraphs, harmonic analysers, and compound integrators. We have summaries of the mathematical theories involved, diagrams of the mechanisms, and pictures of the different machines that have actually been constructed. No written account can be equivalent to inspection and use of the machines themselves; allowing for this fact, the author seems to have done all that could be expected. By the way, we wonder what the author of "Erewhon" would have said if he had been shown machines for doing sums, and predicting tides, and calculating moments of inertia.

(4) Dr. Salpeter's work is chiefly interesting as an example of a course in higher mathematics for medical men and men of science drawn up by an author acquainted more or less with modern pure mathematics. As might be expected, he appeals mainly to intuition; but he gives a whole introductory chapter to the notion of a limit, he proves $\partial^2 z/\partial x \partial y = \partial^2 z/\partial y \partial x$, when it can be proved, by the mean value theorem, and gives in an appendix some examples of discontinuous functions. For some reason, not apparent, there is a chapter on the second law of thermodynamics; in other respects the scope of the book is not of an unfamiliar kind; we have differential and integral calculus treated separately, then ordinary differential equations of the second order, and then some easy cases of definite integration. Naturally, many of the examples are chosen to illustrate physical or chemical formulæ.

(5) Dr. Goodwin's work is based on a course given by him for years past in the Massachusetts Institute of Technology. The sort of problem he deals with is such as: "Calculating g from $\pi^2 l/t^2$, how closely should l, t be measured, so that the resulting value of g may be true within 0·1 per cent.?" He quotes, without proof, certain results of the theory of errors; in other respects the discussion is quite elementary, and includes a section on graphical methods. We can quite believe that a course of this kind has been of great value to the Massachusetts students; whether an actual course is given or not, laboratory students must become familiar with the connection between the probable values of their data and the probable value of their result. Dr. Goodwin gives a set of seventy-nine unsolved questions, which teachers of physics would find very useful exercises.

(6) Prof. Cullis associates with any rectangular

matrix an expression he calls its determinoid. This is, in fact, a sum of maximum determinants, taken from the matrix, with a rule of sign for each. There can be no doubt of the value of the theory of matrices, and that a good book on the subject is a desideratum. Whether the notion of a determinoid is likely to be anything like so valuable is a doubtful question, and we confess that we would rather have had a treatise on matrices alone. The present volume ends with a chapter on the solution of any system of linear equations, and to read this first of all is perhaps the best way to become favourably impressed by the treatise. The earlier chapters seem rather diffuse, and contain a large number of new technical terms, some of which, like "corranged," are not at all attractive. The next volume will contain applications to algebra and geometry, besides a discussion of matrix equations of the second degree. When this appears it will be easier to form a judgment on the work as a whole; meanwhile, we can see that it contains a great deal of valuable matter expressed in one consistent notation. G. B. M.

OUR BOOKSHELF.

Brands Used by the Chief Camel-owning Tribes of Kordofan. (A Supplement to "The Tribes of Northern and Central Kordofan.") By H. A. MacMichael. Pp. viii + 40 + xvii plates. (Cambridge University Press, 1913.) Price 6*s.* net.

NEARLY thirty years ago Robertson Smith lamented that no good collection of *wasm* (the tribal marks with which every Arab tribe brands its cattle) had been made, and now Mr. MacMichael has published as a pendant to his history of the Arab tribes of Kordofan a collection of the marks used by these tribes as camel brands. The utility of such a work to the members of the Sudan Civil Service is too obvious to need accentuation, but there is also a good deal of scientific interest attaching to it, although the writer's experience in the Sudan makes him regard it as improbable that the high hopes cherished by Robertson Smith will be realised, that such collections will enable us to trace the ancient history of the people.

No doubt each tribe, or each section of a nomad tribe, once had a distinctive brand, but it seems that in many cases this has been lost, or at least has fallen into disuse. The brands themselves are for the most part named after common objects, such as *bersham*, the "cross-hilt of a sword," and *bab*, "a door," while others derive their names from the part of the camel which is branded; thus, *bakkai*, derived from the word meaning "to weep," is applied to a linear vertical mark below the eye, because it is here that tears trickle down. Generally the brand is highly conventional and unlike the object it represents, but in a few cases, though simplified, it retains all the essentials of the original, as, *e.g.*, the *rigl el ghorab*, a "crow's-foot," used by some of the negroid "Arabs" of the northern hills.

Rainfall Reservoirs and Water Supply. By Sir A. R. Binnie. Pp. xi + 157. (London: Constable and Co., Ltd., 1913.) Price 8*s.* 6*d.* net.

IN the application of exact meteorological observations to practical life, the utilisation of rainfall records by the waterworks engineer takes a foremost place. Rainfall is moreover among the most important of the natural resources of a country, and it is fitting that Sir Alexander Binnie should put together the results of his wide experience in a book which will impress the townsman with this fact in its more direct association with his daily life, in addition to giving to the engineer a survey of the problem with which he is faced, and of the methods of dealing with it.

The first chapter treats of the measurement of rainfall and the variation in amount from year to year and place to place; diagrams are given to show how the total fall increases as the ground rises, and emphasis is laid upon the fact that in a region with a prevailing wind direction the maximum rainfall frequently occurs on the lee side of the high ground. Another diagram illustrates the approach of the average annual rainfall to a normal value as the number of years increases; thus one year may be 50 per cent. above or 40 per cent. below the normal, but the average of ten years is not likely to differ by more than 10 per cent. in either direction from the normal value.

The next chapter deals with the flow from the ground, floods, and evaporation, about which our knowledge is very deficient owing to the scarcity of trustworthy records. Subsequent chapters are devoted to the methods of calculating the available supply, the construction of reservoirs, and the arrangements for conveying the water from the source and distributing it to the users. There is much that is technical naturally in these chapters, but the subject is treated in such a way that even the details are made interesting, and their importance for safety or economy is clearly shown. E. G.

Planetologia. By Ingegnere Emilio Cortese. Pp. vii + 387. (Milan: Ulrico Hoepli, 1913.) Price 3 lire.

IN view of the fact that nearly 300 pages are taken up with terrestrial phenomena, and only eighty pages are devoted to the remaining members of the solar system, the title "Planetologia" scarcely seems suitable for the present book. Perhaps the author could not think of a more suitable title.

The book contains an exposition of some of the main physical properties of the earth's crust, the age of the earth, its past geological history, the theories of tides, earthquakes, volcanoes, the origin of the earth's atmosphere, and the principal

physical features of the planets and moon. As a geologist the author claims to have formed definite views of his own on these questions, differing in many respects from commonly accepted theories; but, as he points out, it would be impossible for a writer to substantiate these varied theories unless he had travelled all over the world, besides being, at the same time, a mathematician, a physicist, a chemist, an astronomer, and a geologist. Considerable attention is given to theories of the displacement of the earth's axis.

A collection of theories of this kind, if thus propounded in a proper spirit, is not only interesting, but it opens up useful material for future discussion. On the other hand, not the least important feature is the insight which the book affords the general reader of known physical facts and phenomena connected with the earth and planets.

A Manual of School Hygiene. By Prof. E. W. Hope, E. A. Browne, and Prof. C. S. Sherrington. New and Revised Edition. Pp. xii+311. (Cambridge University Press, 1913.) Price 4*s.* 6*d.*

THE first edition of this manual, which was reviewed in our issue for August 15, 1901 (vol. lxiv., p. 373), was reprinted on three occasions before the appearance of the book in its present form. Six chapters on physiology by Prof. Sherrington have here been added. They aim at emphasising the salient portions of the subject, and deal with the body considered as a mechanism, the blood and its circulation, respiration, food and digestion, the temperature of the body, and muscle and nerve.

Library Cataloguing. By J. Henry Quinn. Pp. viii+256. (London: Truslove and Hanson, Ltd., 1913.)

MR. QUINN'S book should prove of real service as a guide for young librarians to the various codes of cataloguing rules. His bright, helpful chapters should certainly convince the beginner in library work that the office of librarian is no sinecure; and the arrangement of his matter, and the subjects chosen for treatment, should enable information on practical cataloguing to be obtained with a minimum expenditure of trouble.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Energy in Planetary Motions.

IF a particle of mass m be brought from infinity to distance r by the action of a central attraction varying as the inverse square of the distance, the potential energy exhausted in the process is $m\mu/r$, where μ is the "intensity of the centre." If the particle has experienced no resistance to its motion the kinetic energy is given by the equation

$$\tfrac{1}{2}mv^2=m\frac{\mu}{r}.$$

But if the particle be made to move in a circle of radius r about the centre of force, the speed v is given by

$$v^2=\frac{\mu}{r};$$

and the kinetic energy $\frac{1}{2}mv^2$ represents only half the potential energy exhausted. The other half must have been dissipated or disposed of in some way or other.

Similarly, if the particle be brought in from motion in a circle of radius r' about the centre to motion in the circle of radius r, so that potential energy of amount $m\mu(1/r-1/r')$ is exhausted, the kinetic energy has been increased by only $\frac{1}{2}m\mu(1/r-1/r')$, so that again only half of the potential energy exhausted is represented by the orbital motion, and the remainder has been expended in doing work against resistance of some sort. The central force has, in fact, done exactly twice as much work as that represented in the increase of the kinetic energy.

All this, of course, is perfectly elementary and well known, but it is nevertheless a curious dynamical fact that exactly half of the work done by the attraction must be expended in overcoming resistance.

I have not seen the corresponding theorem in elliptic motion anywhere explicitly stated. It is as follows:—*The time-average of the kinetic energy, taken for one revolution in the orbit, is half of the corresponding time-average of the potential energy exhausted in the passage from infinity to the distance* r. A similar theorem holds, of course, for the differences of energy concerned when the particle is transferred from one orbit to another about the same centre.

Let $2a$ be the length of the major axis of the elliptic orbit. The speed v at distance r from the centre is then given by

$$\tfrac{1}{2}v^2=\mu\left(\frac{1}{r}-\frac{1}{2a}\right),$$

which, multiplied by m, is the equation of energy. The potential energy exhausted from infinity to distance r is again $m\mu/r$, and it can easily be shown that the time-average of the kinetic energy in the orbit is $m\mu/2a$.

Parenthetically, it may be remarked that this result is most easily and elegantly established by the following Newtonian process. If when r is the distance of the particle from the centre of force (one focus of the ellipse) r' be the distance from the other focus, and p, p' be the lengths of the perpendiculars from the foci on the line of motion at the instant, we have $r/r'=p/p'$, and, therefore, since $pp'=b^2$, where b is the length of the semi-minor axis, we have $r'/r=p'^2/b^2$. But the equation for v^2 can be written

$$v^2=\frac{\mu}{a}\frac{2a-r}{r}=\frac{\mu}{a}\frac{r'}{r}.$$

Hence integrating for a period of revolution T we get

$$\int_0^T v^2dt=\int vds=\frac{1}{b}\sqrt{\frac{\mu}{a}}\int p'ds,$$

where ds is an element of the path, and the integrals with respect to s are taken once round the ellipse. Now, clearly $\int p'ds$ is twice the area of the ellipse—that is, $2\pi ab$. Thus

$$\tfrac{1}{2}m\int_0^T v^2dt=\pi m\sqrt{\mu a}.$$

The period T is $2\pi\sqrt{a^3/\mu}$, and so the mean kinetic energy is

$$\frac{\pi m\sqrt{\mu a}}{2\pi\sqrt{\frac{a^3}{\mu}}}=m\frac{\mu}{2a}.$$

If we take the time-integral of both sides of the energy equation once round the path we get the theorem of elliptic motion stated above.

It may be remarked that $2m\pi\sqrt{\mu a}$ is the *action* for one revolution of the particle in its orbit, and thus we have the curious result (already known) that the action (and therefore the mean kinetic energy) for one complete revolution in an elliptic orbit is independent of the eccentricity. If the centre of force be shifted along the major axis, so that for different orbits about the centre of force the length of the major axis remains unaltered, the period and the action remain also unchanged.

It may be noticed that the process used above shows very clearly that the area traced out by the radius vector from the "empty focus" is proportional to the *action*, for the time given by the corresponding area traced out by the radius vector from the centre of force. I observed this fact some years ago, but found that it had previously been put on record by Tait.

For a hyperbolic path round the centre of attraction the energy equation is

$$\tfrac{1}{2}mv^2=m\mu\left(\frac{1}{r}+\frac{1}{2a}\right),$$

where $2a$ is the distance between the vertices of the two branches of the hyperbola; and we see that in this case the kinetic energy at distance r *exceeds* the potential energy exhausted in the transference from infinity to that distance by the mean kinetic energy of the motion in an ellipse of semi-major axis a. Thus if a planet formed in the course of the condensation of a nebula is to have a hyperbolic orbit, it must, by an explosion of chemical energy, or by some other convulsion or process, have a quantity of kinetic energy given to it, in excess of that produced by the transference of the matter from infinite dispersion in space. In the evolution of planets according to the nebular hypothesis hyperbolic orbits would thus be exceptional cases.

It may be noted that in a certain sense $m\mu/2a$ is also the mean kinetic energy in the hyperbolic orbit. For, when r has become considerable, $\frac{1}{2}mv^2$ is sensibly equal to $m\mu/2a$, and the time for this sensibly constant value is infinite. A. GRAY.

Boat of Garten, July 23.

"Phosphorescence" of Pennatulida.

PROF. NEWSTEAD and I have had two of the few British Pennatulida—*Pennatula phosphorea* and *Funiculina quadrangularis*—"phosphorescing" to-day before our eyes, so it may be worth recording the impressions while they are fresh. *Pennatula phosphorea*, as its name indicates, has long been known to emit light, and, writing from memory, I think Sir Wyville Thomson, in his "Depths of the Sea," refers to the "lilac phosphorescence of Pavonaria" (=Funiculina). Prof. Newstead and I have just seen the colour and distribution of the light very clearly in a makeshift dark-room (the lazarette of the yacht), and also on the deck at midnight. In Funiculina the distribution of the luminosity is very curious and quite different from that of Pennatula. There are many distinct sparkles over the polype-bearing part of the colony (corresponding, no doubt, to the individual polypes), but the long, bare lower part of the stem, 9 in. to a foot in length, when gently stroked in the dark glows with a continuous sheet of light of (it seems to me) a pale-green colour which flickers or pulsates like a lambent flame. The light on this bare part of the colony is certainly more intense than that of the polypes, and is the most brilliant "phosphorescence" I have seen in any marine animal. I have not seen Pyrosoma alive, but I imagine from the descriptions it may be even more brilliant than Funiculina.

In Pennatula, on the other hand, the light appears to be restricted to the polypes. I have not been able to excite any luminosity in the stem portion of the colony, but the illumination of the polypes is very general and beautiful—more general and more lasting than the sparkles that the polypes give in Funiculina.

Prof. Hickson, in a letter just received, asks me, if possible, to observe the phosphorescence of the other British Pennatulid, *Virgularia mirabilis*. I have not yet succeeded in dredging Virgularia here, but it ought to be found in these waters, and probably when examined alive in the dark will show some degree of phosphorescence like its two relations referred to above.

We have been able to get detailed colour notes of the living Funiculina, and some photographs of polypes extended to nearly an inch in length, which we hope may be useful. W. A. HERDMAN.

S.Y. *Runa*, Loch Sunart, N.B., July 26.

A Red-water Phenomenon due to Euglena.

A VERY remarkable red-water phenomenon is at present observable in a small pond in Broad Oak Park, Worsley, near Manchester, just in front of the seventh tee on the golf course. The surface of the pond—at any rate at times—is covered in places with an almost blood-red scum, which seems to float on the surface film like fine dust. The scum sometimes assumes a greenish hue. Microscopical examination shows that it is due to the presence of immense numbers of a large species of Euglena, the green chlorophyll of which, as in the case of Hæmatococcus, is more or less replaced by red hæmatochrome.

On keeping some of the water and scum under observation in a soup-plate, it is seen that the organism occurs chiefly in two conditions—crawling on the bottom in an elongated form, and resting on the surface in a spherical form. It does not seem to swim freely about in the intermediate zone of water, so that the red colour is confined to the bottom and the surface, and not, as in the case of the active form of Hæmatococcus, dispersed through the water itself. Crawling seems to be effected by typical "Euglenoid" contractions, but a very long flagellum is sometimes visible at the anterior end, while the posterior extremity is formed by a sharp projection free from pigment.

Since writing the above I have been able to observe how the Euglenæ reach the surface of the water. They evidently secrete some sort of slime in which they become entangled. Bubbles of oxygen gas, given off by the Euglenæ in presence of sunlight, are also caught in this slime, and when these reach a certain size they rise to the surface, trailing strings of slime, with numerous entangled Euglenæ, after them.

ARTHUR DENDY.

University of London, King's College, July 30.

The Terrestrial Distribution of the Radio-elements.

IN my letter of June 19 I briefly outlined three arguments which consistently point to a concentration of the radio-active elements in the earth's crust, such concentration having been accomplished at the expense of the material of the interior. The first of these

arguments (in which the limited distribution of the radio-elements is deduced from the earth's temperature-gradient) is made the basis of a revival of Arrhenius's view that radio-active disintegration may be inhibited under the conditions prevailing at great depths (NATURE, June 26, July 10, and July 17). Thus, in place of the deduction that the amounts of uranium and thorium existing in the earth's interior are negligible, even thermally negligible, is put forward the alternative deduction that these parent elements are not necessarily absent, but only temporarily impotent, their output of energy, by which alone we could be aware of them, being inhibited by the enormous pressures to which they are subjected.

The latter alternative is favoured by the philosophic conception embodied in Le Chatelier's law of reaction, viz. that the internal reactions within a material system are such as will tend to oppose any external influences by which its equilibrium may be disturbed. It would at once be deduced from this "law" that radio-active transformations, implying as they do an immense output of energy in the form of electronic and atomic bombardments, must be inhibited by the application of sufficiently high pressure and temperature. Under high pressures the internal reactions will tend to oppose the pressure and therefore an increase of volume, and similarly under high temperatures the internal reactions will tend against a further rise of temperature. The internal reaction is favoured which results in the absorption of energy from an external source. Hence, radio-active changes, involving increase of volume and rise of temperature, would presumably be opposed by the physical conditions of the earth's deep interior.

As yet, however, we are unable to assert whether this deduction may safely be made to the extent of assuming inhibition. Frankly, it is a step taken in the dark. The law of reaction is known to be a useful guide as regards the tendency of molecular activities; its extension to include the internal activities of atoms has yet to be demonstrated. The evidence from direct experiment is manifestly insufficient, but so far as it goes it betrays on the part of the radio-elements an astonishing disregard for all external influences. For the present, then, the problem stands unsolved, as indeed it must remain until we know more of the internal mechanism of the radio-active atom.

However, whether one favours radio-active inhibition or independence, the remaining arguments in support of a crustal concentration of radium stand unaffected. The highest concentration of the radio-elements is found in the acid rocks, which contain six times as much radium as the ultra-basic rocks. That is to say, the lighter rocks in their capacity as solvents are capable of carrying a higher proportion of the radio-elements than are the heavier rocks. It is for this reason that uranium, which is the heaviest element of all, has not gravitated to the earth's metallic core, as Dr. Schiller considers would be most probable. Further, there is clearly a marked antipathy between the radio-elements and native iron, for in all the terrestrial examples of the latter which have been examined, uranium and thorium are barely detectable. Correlating these facts with the earth's trizonal structure, we should expect an internal metallic core free, or nearly so, from the radio-elements, an intermediate zone originally poor in, and now almost devoid of, these elements, and an outer crust more richly endowed, its wealth of radium, like its wealth of silica (and perhaps of many of the metallic ores), having accumulated in the course of the earth's evolution at the expense of the more sparsely distributed internal stores.

On the parallel drawn by Daubrée and extended by Suess between iron meteorites and the earth's metallic core and between stony meteorites and the earth's intermediate ultra-basic zone, this conception receives still more convincing evidence. The stony meteorites are even more poverty-stricken in radium than the ultra-basic rocks, and the iron meteorites contain no radium whatever. ARTHUR HOLMES.

Imperial College, London, S.W., July 18.

Area of Earth's Surface Visible at any Altitude.

IN these days of aviators and of record heights attained by them, perhaps the following rule to find the area of the earth's surface visible from a given height may be of interest. The rule depends upon the fact that if the height above a sphere is $\frac{1}{x}$th part of the sphere's diameter, then the area visible from this height is $\frac{1}{x+2}$th part of the sphere's total area. This admits of an easy geometrical proof.

Rule.—Express the height above the earth's surface as a fraction of the earth's diameter; multiply the numerator of this fraction by 2, and add the result to the denominator, then the resulting fraction gives the fraction of the earth's surface visible.

Examples.

Height above earth's surface	Height expressed as a fraction of earth's diameter	Fraction of earth's total surface visible
24,000 miles	$\frac{3}{1}$	$\frac{3}{5}$
8,000 ,, ...	$\frac{1}{1}$	$\frac{1}{3}$
70 ,, ...	$\frac{1}{800}$	$\frac{1}{814}$
1 mile	$\frac{1}{8000}$	$\frac{1}{8002}$
506·881 in.	$\frac{1}{999998}$	$\frac{1}{10^6}$
42·24 ft.	$\frac{1}{10^6}$	$\frac{1}{10^6+2}$
At the moon (240,000 miles)	$\frac{30}{1}$	$\frac{30}{61}$

Of course, the effects of refraction are neglected; otherwise the rule is strictly accurate.

W. Moss.

Municipal Secondary School, Bolton.

Submerged Valleys and Barrier Reefs.

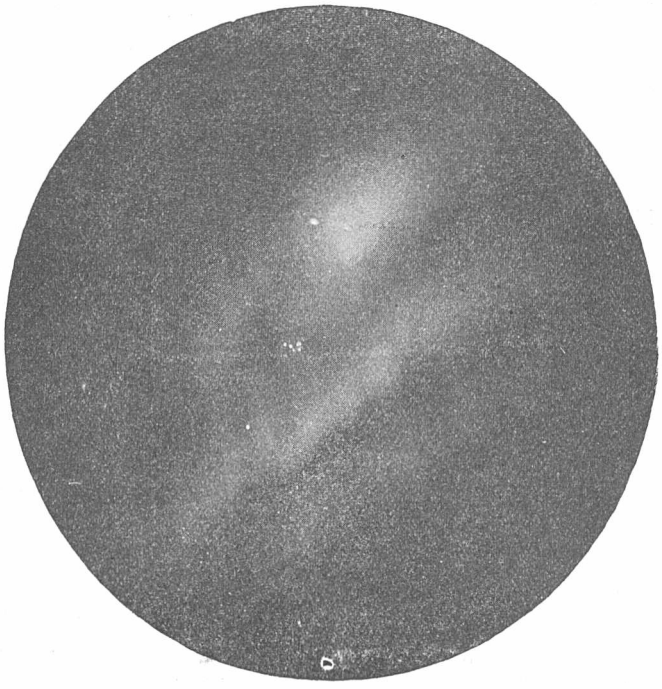
As I have never visited the Pacific Islands, I do not attempt to bring their valleys under the same category as those of the coast of the Red Sea and East Africa. Darwin's theory having been so often held to apply to all barrier reefs, it seemed to me interesting to refer to cases to which that theory does not apply, though superficially resembling that cited by Prof. Davis (NATURE, February 6 and June 26).

I wished also to emphasise the resemblance between fault and subaërial erosion valleys, and in spite of Prof. Davis's assertion that they can be distinguished readily I think we need definite assurance that those he cites are without doubt of the latter kind. Given that assurance, Dana's proof of Darwin's theory holds true for that case, but not universally wherever barriers (and atolls) are found. I myself took it for granted that those of Pemba and British East Africa were due to erosion by streams and tides alone, until I compared the better preserved examples of this almost rainless climate. CYRIL CROSSLAND.

Dongonab, Red Sea, July 12.

PHOTOGRAPHS OF THE AURORA.

AN important advance in the knowledge of the aurora is the outcome of the spring expedition to Bossekop, under M. Carl Störmer. This expedition was undertaken to complete the work done in the 1910 expedition, which was so fruitful of results. The experience gained on the first occasion has been most successfully utilised, and M. Carl Störmer has recently but very briefly communicated an account of the research to the Paris Academy (*Comptes rendus*, June 16).



Bossekop.

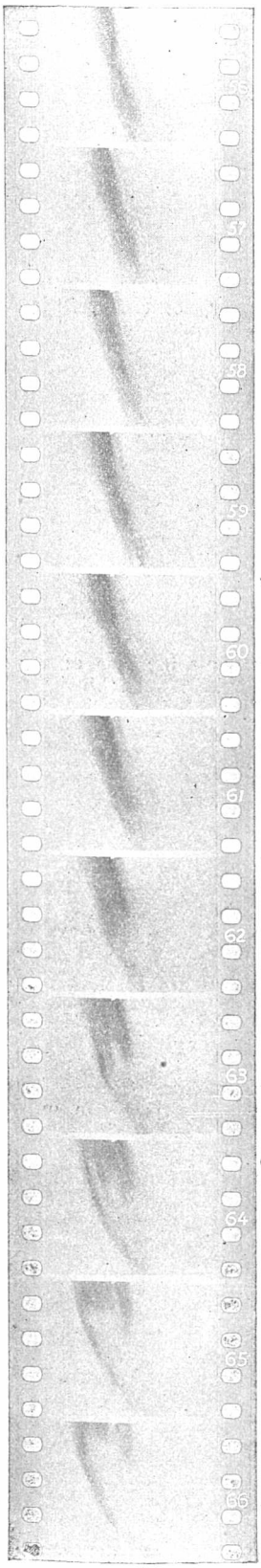
Korsnes.

FIG. 1.—Photograph of the same aurora taken on March 3, 1913, at 10h. 36m., Central European time, from Bossekop and Korsnes.

From February 28 to April 1 of the present year the expedition secured 636 pairs of simultaneous photographs of the aurora at the two stations, namely, Bossekop and Store Korsnes, the latter station being about 27 kilometres to the north of Bossekop. Of these photographs 450 pairs are stated to be very satisfactory and furnish material sufficient to compute with a large degree of accuracy the form, position, and altitude of all the principal kinds of aurora borealis.

Further, exactly at the same time as the photographs of the aurora were taken, other photographs, with a prismatic camera, were secured. On these latter photographs can be seen not only the spectra of the stars, but several superposed impressions of the auroræ corresponding to different spectrum lines.

As in 1910, a kinematograph was employed to try to secure the changing phases of the aurora: for the most part the auroral images were too faint. On three occasions, how-



Kinematographs of Aurora.

ever, when the auroræ were very bright, consecutive exposures were given, lasting from 0·5 second to 1 second for each image.

Another series of about 100 photographs was taken on April 8 with the kinematograph, each exposure lasting about four seconds. These photographs demonstrate the great utility of this instrument not only in obtaining consecutive features of the displays, but in securing ordinary photographs at the two stations. The communication is accompanied by two most interesting plates. The first of these shows excellent reproductions of the aurora on March 3, photographed at the two stations at the same time, with clear impressions of the stars, demonstrating at a glance the parallactic effect (Fig 1). The second plate reproduces four portions of the kinematograph strip exposed on April 8 at Bossekop. These speak for themselves in indicating the valuable aid the kinematograph brings to auroral studies. A portion of these strips is here reproduced, the exposures for each portion being four seconds (Fig. 2). The gradual change in form and density of the filaments illustrated is here clearly indicated. M. Störmer states that the results of this expedition will be published in considerable detail in a subsequent memoir, and the above brief summary is sufficient to show that the memoir will be a most valuable contribution to our knowledge of the aurora.

THE INTERNATIONAL MEDICAL CONGRESS.

THE International Medical Congress, which is now meeting in London, may fairly be described as the greatest scientific congress ever held in the metropolis; for the time has gone for ever when a medical congress can be confined to the sciences commonly thought of as medical, and it is probable that the future will remember with most gratitude those contributions to the present congress which may seem to have the least relation to medicine.

No single fact marks better the advance of medical thought since last the congress met in London, thirty-two years ago, than the delivery of an address by Mr. W. Bateson on heredity. The supreme names of the past may have no living parallels, but their work bears fruit. Pasteur is gone, but the bacteriologists are all in force at the congress, and his pupil Laveran, who discovered the parasite of malaria a generation ago, is here to see, at any rate in tropical medicine, something like the realisation of his master's *dictum* that "it is in the power of man to make all parasitic diseases disappear from the earth." Lister is not here, but Prof. Cushing can scarcely fail to refer to the surgery of the pituitary body, which seemed wildly impossible only a few years ago. Jonathan Hutchinson is not here, but Prof. Ehrlich will report on the modern treatment of syphilis, though Schaudinn, who found the spirochæte, did not live to hear of salvarsan.

The congress will greatly serve science, but it may still more greatly serve public opinion, and even develop something like public wisdom in some respects. The international resolution on the value of vivisection will be an illustration of this, and also the discussion on alcohol and degeneracy; but most may be hoped from the discussion, in the Albert Hall itself, of the duty of the State in respect of syphilis. This can scarcely fail to reinforce the demand for a Royal Commission lately made by the leaders of medicine in this country, supported by the British Medical Association at Brighton, and repeated by the English-Speaking Conference on Infant Mortality in London on Tuesday, on behalf of absolute innocence, now commonly murdered by our immoral neglect of this subject.

THE RIVERS OF THE SCOTTISH LOWLANDS.[1]

THE handsome volume before us is about evenly divided between the physiographic and industrial questions of the Forth area, and in this combination of interests serves to remind us of the enormous scope of modern geography.

Mr. Cadell has qualified himself to be the historian of the Forth by a long period of service in the Geological Survey of Scotland; and for the subjects treated in the latter half of the book by an almost equally long period of public service in the Lothians.

The history of the Forth begins naturally with the origin of the solid rocks which form the floor of its valley. These foundation-stones were laid in the far-off times of the Old Red Sandstone lakes and the steamy swamps of the Carboniferous. In the first three chapters an excellent light treatment of the many points of interest in connection with the deposition of these rocks, especially the economic materials they contain, is given. After the formation of this basement there must have been a long period of peneplanation, then submergence, and finally re-emergence of the peneplane with a slight tilt *en bloc* to the east. This tilt determined the direction of the Forth and other consequent rivers.

The most original and interesting portion of the book, perhaps, is that which deals with the development of the river system. The Forth, however, cannot be treated in this respect as a separate entity. Its origin involves that of the Clyde and Tweed, and also the lochs of Dumbartonshire and Argyllshire. The Forth originally rose in the highlands of the latter counties, but its headwaters were captured by an energetic stream which flowed southward down what is now the Firth of Clyde. The well-marked narrow trench crossing the Midland Valley from Clydebank to Grangemouth is now occupied by small streams totally disproportionate to its size, and is regarded by Mr. Cadell as the course of a former large tributary of the Forth. The Clyde

[1] "The Story of the Forth." By H. M. Cadell. Pp. xvii+299+plates (Glasgow: James Maclehose and Sons, 1913.) Price 16s. net.

system has thus been formed largely at the expense of the Forth, and in its later depredations has also appropriated part of the Tweed. It has been favoured by the comparatively soft rock-material along its earlier course, by its steeper gradient, but most perhaps, by the more copious rainfall of the western mountains.

The subsequent Glacial period, although causing considerable modification in detail, has not altered the essential features of the topography developed by the rivers. Neither has the submergence which has drowned the seaward parts of the Clyde and Forth valleys, and transformed the Clyde system especially into a series of sea-lochs, availed to obscure the ancient lines of the drainage-system, of which Mr. Cadell has given such a luminous explanation.

Much scattered information on related physiographic subjects, such as the buried channels of the Forth valley and the old lochs of the Edinburgh district, is brought together for the first time in this book.

The latter half of the book deals with industrial subjects connected with the Forth valley. The famous Carron Company and the rise of the Scottish iron industry are treated in chapters ix. and x., and we are reminded how great a part the Cadell family took in the establishment of this great concern in the latter half of the eighteenth century. We also note that Mr. William Cadell, after leaving the Carron Company, interested himself in the establishment of the Clyde Ironworks at Old Monkland, near Glasgow, and thus helped to lay the foundations of the iron-smelting industry in the west of Scotland.

The final chapters deal with land reclamation in the Forth valley, and a very interesting account of an old labour colony is given. This was established by Lord Kames in 1766 for the clearing of Blairdrummond Moss, a work which turned a quaking bog into a fertile plain that now supports scores of families. These later chapters are most interesting and readable, although garnished here and there with obsolescent economics. The book is finely printed, and is a pleasure to read and handle. It is illustrated by many excellent plates and maps.

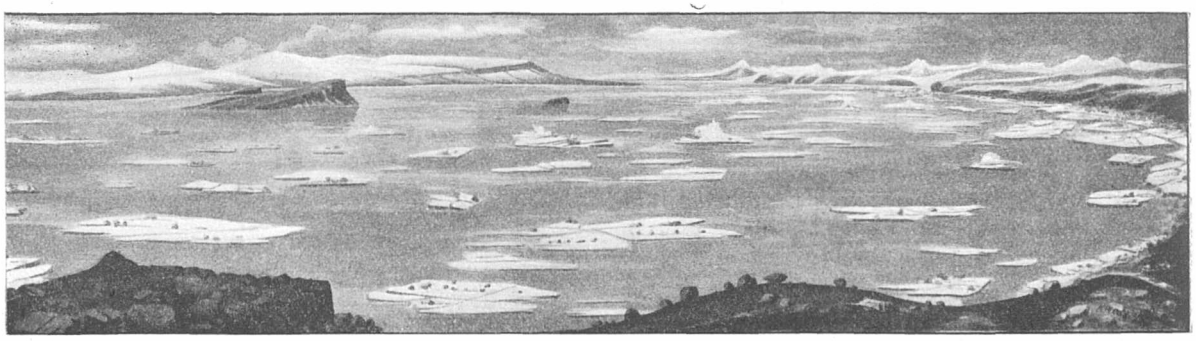


FIG. 1.—Scene at the end of the Ice age when the valley was submerged under an icy sea.

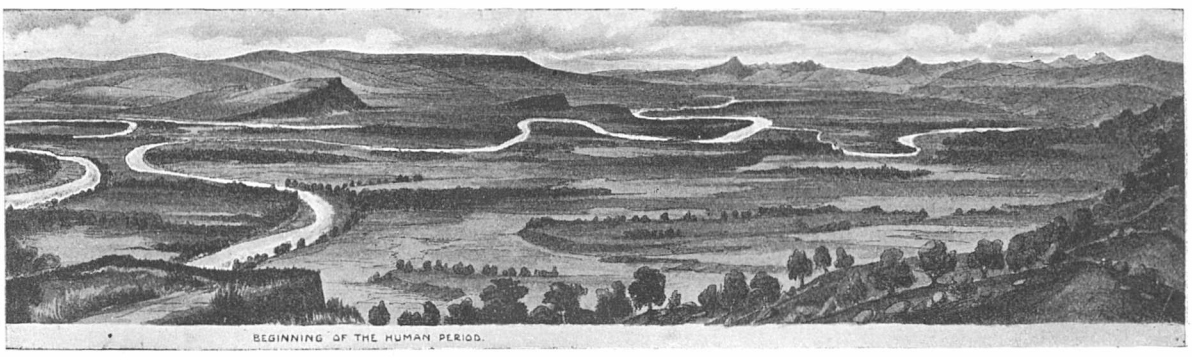


FIG. 2.—The modern landscape after the sea had retreated to its present level.

Panoramas from the Craig at Stirling at different periods in the history of the earth. From "The Story of the Forth.

THE IMPROVEMENT OF INDIAN WHEAT.[1]

NOWADAYS, when the English miller regards Indian wheat as a valuable addition to his resources, the work of the authors of this memoir in improving it is of the utmost national importance. The progress they have made already deserves to be widely known and commended. The problem is the same as that which confronts us in this country, where, however, the farmers still refuse even to try to understand it—namely,

[1] Memoirs of the Department of Agriculture in India, vol. v., No. 2. By A. Howard, H. M. Leake, and G. L. C. Howard, Agricultural Research Institute, Pusa.

the introduction of a strain of wheat, of easy cultivation, which will combine high yield with quality and give a satisfactory straw. Usually in India, as elsewhere, the consistency of a wheat varies greatly, according to the conditions under which it is grown. Although weak wheats can be improved to some extent in milling and baking qualities by cultivation, they have not been made to behave like strong wheats. Owing to the shortness of the growth-period and the liability of the water-supply to deficiency, moderate-yielding wheats are on the average the most profitable to the grower. The Pusa experiments, which have been in progress since 1907, show that the strong wheats with good milling properties retain these properties both under canal irrigation and on the black soils, and that high yield and high quality can be combined in the same wheat.

Such adverse factors as waterlogging and late cultivation affect both the yield and quality of the wheat, and the ryot requires training to the fact that rice conditions of drainage will not do for wheat cultivation. As elsewhere, the greatest financial return for the labour is obtained by growing to perfection a wheat which combines yield with quality.

We believe that the type of wheat preferred by the natives for their home consumption is altogether different from the strong wheat so desired for the export market: the authors ignore this point, but it would appear undesirable to sacrifice the home to the export market for the sake of such an elusive quality as strength.

E. F. A.

PROF. JOHN MILNE, F.R.S.

TO few men is it given to follow the growth of a new science from its infancy to maturity, and to still fewer to be prime movers in bringing about such a development. Nevertheless this is the claim we can confidently make for Dr. John Milne. He found seismology in its embryo stage, as left by the pioneer Robert Mallet—with its instruments of the most unsatisfactory type, its observational methods of the crudest description, and its inferences far from conclusive—but he lived to see well-equipped seismographical observatories scattered all over the globe, seismological societies established in every civilised State, and the science of seismology universally recognised as an important and highly suggestive branch of geophysics. And it was undoubtedly to Milne's genius and energy that the impulse leading to these results has been largely due. Yet he had not reached the age of sixty-three when he died on July 31, and his earthquake studies were comprised within a period of thirty-five years!

The two halves of this period of incessant activity had each its particular outlook—the first mainly confined to earthquake-shaken Japan; the second extending to the whole globe. At the early age of twenty-five, Milne, a student from the Royal School of Mines, with a short experience in Newfoundland, Labrador, and Arabia, was appointed Professor of Geology and Mining in the University of Tokyo. Active as the young professor was in his teaching work, writing text-books on crystallography and mining, and conducting expeditions to study the volcanic and other phenomena of Japan and neighbouring lands, it was, nevertheless, outside his official duties that he began to find the fullest scope for his superabundant energies.

It was the frequent earthshakings of his adopted country that supplied food to Milne's inquiring and speculative mind. Before he was thirty he had founded the Seismological Society of Japan, and a seismological journal; but for the first ten years at least Milne might have truthfully asserted, "I am the Seismological Society, and I *write*, as well as *edit*, the journal." He established observing stations all over Japan, eventually reaching nearly 1000 in number, each of which was supplied with a register in the form of a cheque-book, and the "cheques," filled up with answers to questions in Japanese and English, when posted to Milne, supplied him with the means of drawing "isoseismal" lines on his maps for each shock. But this laborious task, with earthquakes of almost daily occurrence, was only a small part of his work. He invented and improved various forms of recording instruments, investigated the laws of transmission of vibrations through the earth's crust by "artificial earthquakes," studied the principles on which buildings that should be "earthquake-proof" may be constructed, registered the meteorological conditions under which earthquakes occur, and perseveringly followed innumerable clues in diverse directions that continually suggested themselves to his ever-open mind.

Not the least important part of his work was the training a band of native observers, who are ably continuing and extending Milne's investigations in Japan. More than one hundred memoirs, filling more than two-thirds of the nineteen volumes of the Transactions and Journal of the Seismological Society of Japan, constitute the best evidence of Milne's devotion to the science during his seventeen years of residence in the country.

But Milne's retirement from the Japanese professorship at the age of forty-five furnished the opportunity for entering on a wider sphere of labour—one to which he was able to devote the whole of his time and effort. Just before starting for England, however, a most disastrous fire destroyed his accumulated books and instruments—the most serious loss being that of the stock of precious volumes of the Transactions and Journal of his society.

Undismayed by this misfortune, Milne, within three weeks of his arrival at home, had built a brick pillar at Shide, in the Isle of Wight, and set up on it his seismographs. The site of this now famous observing station had been selected from

its proximity to a line of great earth-movements during a late geological period. Established at this centre, he entered upon the task of enlisting the aid of Government departments, public institutions, and private individuals to his great work. Before he died he had the satisfaction of having forty observing stations, all furnished with his own type of seismometer, in constant correspondence with him. The careful tabulation and discussion of the records from these observatories had occupied him during the last seventeen years, and the results have been given to the world in a series of circulars and reports by the British Association, the society which, so far as its means have allowed, has constantly subsidised and published Milne's work; in later years the Royal Society has extended its powerful support to him.

To readers of NATURE it is not necessary to enlarge on the results of Milne's labours since his return to England. His important work in tracing the cause of the fracture of submarine cables; his determination of the sites of distant earthquakes from seismographic records; his proof of the distinction between vibrations that travel *through* the earth, and those going *round* it; and many other suggestive contributions, are familiar to everyone.

No more striking proof of Milne's remarkable activity can be afforded than the fact that while the British Association has, since the year 1841, published fifty-three reports on seismology, in which 562 communications are embodied, no fewer than 463 of these are from the pen of Milne! And all are in addition to his books and numerous articles in scientific and other journals.

The eighteenth (alas! it is the last!) of the luminous reports prepared since his return to England is now in the press, and will be presented at the forthcoming meeting of the British Association. It fittingly concludes with a touching and generous obituary notice of his Japanese assistant, Shinobu Hirota (the faithful "Snow"), who returned home to die last April. But, indeed, Milne's was an ever-generous soul. Students of seismology from all lands visited Shide, and were always warmly welcomed by Milne, often partaking of his hospitality. Not only these, but idle tourists, journalists in search of "copy," teachers with their pupils, and even children, were ungrudgingly received. In spite of his exacting labours, he seemed ever ready to show his instruments and talk about his work with the most casual visitor.

Some, perhaps, may suggest that Milne was wanting in sympathy with the work of co-ordinating the results of other organisations than his own; and it may be admitted that his Pegasus did not run well in harness. But it must be remembered how, from the first, he had been accustomed to bear all the weight and responsibility of great enterprises on his own broad shoulders. John Milne's death is indeed a great calamity for science—how great will only be realised when the attempt is made to supply his place.

J. W. J.

NOTES.

THE Baly medal has been awarded by the Royal College of Physicians to Dr. J. S. Haldane, F.R.S., reader in physiology at the University of Oxford, in recognition of his distinguished contributions to physiological science.

PROF. W. C. MCINTOSH, F.R.S., professor of natural history in the University of St. Andrews, and director of the Gatty Marine Laboratory, has been elected president of the Ray Society in succession to the late Lord Avebury.

THE death is announced of Mr. T. H. Russell, of Birmingham, who was a fellow of the Linnean Society and the author of a work on mosses and liverworts.

A PARAGRAPH in *The Times* of August 2 states that there are 106 clocks attached to premises in the City of London, and observable from the public way. Of these, forty-two are synchronised from Greenwich Observatory. There are, in addition, twenty-nine church clocks in the City (including St. Paul's Cathedral), none of which are synchronised or even unanimous in their irregularity.

IN a letter published in *The Scotsman* of July 24, Dr. John G. Havelock, of Montrose, describes some observations which have led him to conclude that common varieties of the single petunia are true insectivorous plants. Mr. Alex. Johnstone, of the same town, has sent us an account of observations of his own which suggest the same conclusion. Sir Herbert Maxwell, in *The Scotsman* of July 28, thinks *Rhododendron barbabum* also deserves attention as probably an insectivorous plant. Only a careful experiment can determine the accuracy of the suggestion that Petunia is insectivorous, and it may be hoped the point will receive the attention of plant physiologists.

THE exhibited collection of Mesozoic crocodiles in the Geological Department of the British Museum (Natural History) has just been rearranged to incorporate some important recent acquisitions. A new specimen of Mystriosaurus from the Upper Lias of Würtemberg, prepared by Mr. B. Hauff, is one of the finest known examples, with almost complete limbs. The stomach-contents are seen, mingled with swallowed pebbles. A specimen of Geosaurus, from the Lithographic Stone of Bavaria, shows for the first time the triangular tail-fin by which this essentially marine crocodile propelled itself. The unique example of the Wealden river-crocodile Goniopholis, discovered a few years ago by Mr. R. W. Hooley in the cliff near Atherfield, Isle of Wight, and described by him in the Geological Society's Journal, has also been mounted and exhibited.

THE sixtieth birthday of Prof. W. Ridgway was fittingly commemorated a few days ago by a dinner at Caius College, Cambridge, attended by scholars and men of science from all parts of the kingdom. Few archæologists of the present day have done more, by original work, stimulating instruction, and the application of anthropological methods in the solution of historical problems, to advance English scholarship. His treatises "The Origin of Currency

and Weight Standards," "The Origin and Influence of the Thoroughbred Horse," and "The Origin of Tragedy," have advanced our knowledge of prehistoric archæology, while his separation of the northern and southern elements in early Greek history, received at first with almost generally hostile criticism, has passed into the region of orthodox commonplace in the light of the Cretan discoveries by Sir A. Evans. It is much to be desired that the completion of his admirable work, "The Early Age of Greece," will not be much longer delayed.

THE death is announced, in his sixty-sixth year, of Sir Richard Powell Cooper, a distinguished agriculturist, who played a very large part indeed in developing the enormous industry in exporting pedigree live-stock, which has now become a recognised part of British agriculture. He was also a member of the firm of Cooper and Nephews, chemical manufacturers and exporters of live-stock; this firm set up laboratories at Watford and Berkhamsted, and made chemical preparations for agricultural and horticultural purposes, and also conducted a number of investigations bearing on these substances. Sir Richard farmed a large estate at Shenstone Court, Lichfield, and he also owned land and live-stock in Australia, the Argentine, South Africa, Paraguay, Russia, and elsewhere. He was an exceedingly good business man, and introduced business methods into branches of agriculture and horticulture where such methods had previously been wanting. In particular he played a great part in revivifying the Royal Agricultural Society, when a few years ago it came dangerously near to collapse.

As the white man spreads over the tropical regions of the earth, he comes continually into contact with new and unfamiliar forms of disease, often of a deadly kind. One of the most recent additions to the white man's burden is a peculiar malady known as Verruga (or Verruca) Peruana, also as Fiebre de la Oroya, or Carrion's fever, described by Darling as "an infectious disease in which a fever of irregular type, associated with more or less severe anæmia, is followed by a wart-like eruption of the skin and sometimes of the mucous or serous membrane." Two forms of the disease are recognised, malignant and benign. It occurs in certain valleys on the western slopes of the Peruvian Andes at altitudes of from 1000 to 12,000 ft., most often between 2000 and 6000 ft. According to the researches of Mayer, Rocha-Lima, and Werner (*vide* Tropical Diseases Bulletin, No. 12, p. 727), the parasitic cause of the disease is one of the problematic class of organisms known as Chlamydozoa. In a recent letter to *The Times* (July 12) Dr. Anderson states that, according to a telegram from Mr. Billinghurst, President of the Peruvian Republic, it has been discovered by Prof. Townsend, of Lima, that verruga is transmitted by one of the small blood-sucking midges of the genus Phlebotomus. These insects are small, hairy, moth-like flies, widely distributed in tropical or subtropical regions; one species is known to transmit "Papataci fever" in Dalmatia, and by some authorities the dissemination of Oriental sore is also attributed to midges of this genus.

MR. W. M. NEWTON has republished from the Journal of the British Archæological Association for last March an important paper entitled "Palæolithic Figures of Flint Found in the Old River Alluvia of England and France, and called Figure Stones." These are nodules of flint assuming the shapes of animals or of animals' heads. These objects were discussed by Boucher de Perthes in his "Antiquités Celtiques et Antédiluviennes," published in 1849, and by the late Sir John Evans in *Archaeologia*, vol. xxxviii., 1860, the latter eminent authority regarding them as "the effects of accidental concretions and the peculiar colourings and fracture of flint, rather than as designedly fashioned." Mr. Newton has, in recent years, found similar objects in a gravel-pit at Dartford, Kent. In the present paper he describes his fine collection, and suggests their analogy with specimens found in Egypt and elsewhere. The full materials and fine illustrations supplied will enable archæologists to study the facts, which are certainly striking. Meanwhile, the conclusions of Sir John Evans do not appear to be materially affected by the fresh evidence now presented.

A REMARKABLE group of long-snouted representatives of the Lower Tertiary perissodactyle family Titanotheriidæ, from the Uinta beds of Utah, forms the subject of a paper by Mr. E. S. Riggs in the Geological Publications (vol. iv., No. 2) of the Field Museum, Chicago. Four generic types (one of which, Rhadinorhinus, is described as new) are recognised in this group, collectively forming the subfamily Dolichorhinæ.

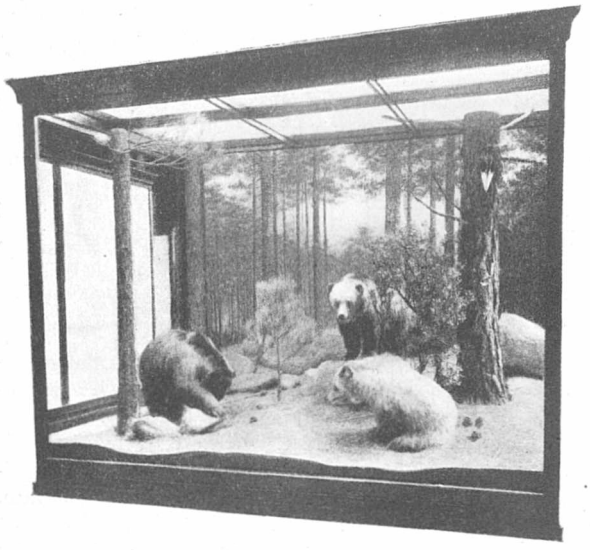
IT is well known to poultry-breeders that birds produced by crossing white Leghorns with black or dark-coloured breeds frequently exhibit a barred plumage ("cuckoo-marking"), of which there is no trace in either of the parent stocks. As the result of experiments, Dr. P. B. Hadley is enabled to demonstrate, in the July number of *The American Naturalist*, that this barring occurs in a certain proportion of such cross-bred birds of the F_2 and subsequent generations, and that the pattern is derived from the white stock. The result of the experiments has, however, no bearing on the ultimate origin of this type of marking, but merely indicates the existence in white Leghorns of factors tending to produce both black and barring.

ACCORDING to an illustrated article by Prof. C. L. Edwards, in the June number of *The Popular Science Monthly*, "abalones," as the various species of Haliotis are locally called, are extensively fished in California, both as a food-supply and for the sake of their shells, which form an important source of mother-of-pearl, and, when polished, are also used as ornaments and as shades for electric lights. A considerable number of pearls are also yielded by abalones. The price of the shells ranges from 1000 to 4000 dollars per ton, and the total value of the shells and flesh taken at Long Beach alone during the year ending in July, 1912, was no less than 95,800 dollars.

TO part 4 of the first volume of *Mitteilungen landwirtschaft. Lehrkanzeln k.k. Hochschule für Boden-*

kultur (Vienna, 1913), Dr. Paul Saborsky contributes an exhaustive and well-illustrated account of Welsh black cattle, in which their characteristic features, corporeal measurements, osteology, and etiology are dealt with in detail. The author fully endorses the opinion that these cattle are nearly related to the extinct black aurochs (*Bos taurus primigenius*) on one hand, and to the white British park-cattle on the other, such resemblances as they display to the Celtic shorthorn (*B. longifrons* or *brachyceros*) being, perhaps, inherited from a local race of the aurochs. It is to be regretted that as the memoir is written in German it is not likely to be widely read in this country.

ACCORDING to the report for 1912 the Field Museum of Natural History, Chicago, continues to make rapid progress, both in the matter of adding to its scientific collections, and in the installation of realistic exhibits in the public galleries and halls. The report is illustrated with photographs of several of these



Sonoran grizzly bears in the Field Museum, Chicago.

striking exhibits, including a group of grizzly bears in a forest and a colony of beavers on a dam in one of the great rivers; in all of these the foreground is occupied by the animals themselves, mounted with their natural inanimate surroundings, while the background is artistically painted.

DURING a visit to a whaling station in the Faröes in the summer of 1911, Dr. L. Freund had the opportunity of studying portions of the anatomy of several species of whales, and has published the results of his investigations in the issue for November and December, 1912, of the *Sitzungsberichte* of the Vienna Academy of Sciences. It may be recalled that a short time ago reference was made in NATURE to Mr. T. B. Goodall's opinion with regard to the homology of the whalebone plates of the whalebone whales. According to Dr. Freund, this opinion is by no means new, but was long since adopted by Eschricht, who contended, in opposition to current views, that the plates do not represent the palatal rugæ of land animals. If we understand him rightly, Dr. Freund appears inclined to support this interpretation, although he points out that there are considerable differences in the structural arrangement of the plates in different groups of whalebone whales. Other items in cetacean anatomy are also discussed in the paper, which likewise contains a section on the genitalia of the porpoise.

WE have received from the Government Printing Office, Calcutta, a series of extremely useful notes on Indian timbers (Forest Bulletins Nos. 16 to 21, price 4*d.* each). The timbers dealt with are *Gmelina arborea, Pterocarpus marsupium, Terminalia tomentosa, Lagerstroemia lanceolata, Ougeinia dalbergoides*, and *Anogeissus latifolia*. Each of these bulletins gives the distribution, locality, and habit of the tree, properties and uses of the timber, minor products, if any, natural reproduction and rate of growth, and other information, and includes a specimen of the wood in the form of a thin section mounted in a stout cardboard frame. These bulletins form part of a series of notes on the lesser-known Indian timbers, compiled by officers of the Forest Research Institute, Dehra Dun, and it is announced that on application to the forest economist specimens of any timber will be supplied free, and inquirers put in communication with local forest officers.

As a result of much recent work on the effect of various metal salts on plant growth in water culture, pot culture, and in the field, the possible value of manganese salts as fertilisers is discussed in a leaflet published by the U.S. Bureau of Soils, Circular No. 75. Beneficial effects have been observed in the cultivation of numerous crops, and in many cases the increase has been very appreciable—upwards of 25 to 30 per cent. Its effect in soils is attributed partly to a direct action on the soil constituents, partly to an acceleration of enzymic changes in the plant, and also to the stimulation of micro-organisms in the soil. It has further been found that manganese increases the absorption of other ingredients by the plant, particularly lime and magnesia. For experimental work and as a complementary fertiliser to sodium nitrate, phosphates, potash, and lime, the use of soluble manganese salts in quantities not greater than 100 lb. per acre is recommended.

IN connection with the movement for the conservation of natural resources in the United States, an investigation has been made into the occurrence of potash salts in such amounts as to warrant their extraction on a commercial scale (U.S. Bureau of Soils, Bulletin 94). In no case has an artificial or natural (subterranean) salt been found suitable for further extraction, but the bitterns derived from the manufacture of salt from sea-water contain potassium in such amounts as to make it probable that they could be evaporated to make valuable manure salts. In addition to this, the brine of one desiccated lake of southern California has been found to contain sufficient potash to make it a possible commercial source, but the largest and most practicable source is to be found in the giant kelps of the Pacific littoral.

WE have received the first part of the *Palaeontologische Zeitschrift* (Berlin: Gebrüder Borntraeger,

price 25 marks annually), the publication of the Palæontologische Gesellschaft, which was founded in Germany last autumn. The society is intended to be of an international character, and besides about 130 German palæontologists, it already counts nearly eighty members in other countries. The headquarters are in Berlin, and a meeting is to be held once a year in some locality, either in Germany or in another country, where there is an important collection of fossils or where the fossiliferous strata are of special interest. The first president is Prof. Otto Jaekel, of Greifswald, and on the council the representatives of Great Britain and the United States are respectively Dr. Smith Woodward and Prof. Charles Schuchert. The published *Zeitschrift* deals with fossils from every point of view, but especially in their biological aspect, and begins with a presidential address on the study of palæontology in general. Prof. Jaekel quotes O. Merkel's claim to have discovered that fossils were intelligently collected even so far back as the Bronze age. One or two examples of each of fifty-eight species of Tertiary shells are said to have been found, with two recent Mediterranean species for comparison, in a cinerary urn of this period. Prof. H. Rauff contributes an important illustrated paper on Pharetrone sponges, and Dr. C. Wiman discusses cases of the sudden destruction and burial of swarms or large troops of animals. Prof. Jaekel also begins an account of the remarkable discovery of numerous dinosaurs and other vertebrates in a clay-pit in the Upper Trias of Halberstadt, north Germany.

To the July number of *Symons's Meteorological Magazine* Mr. R. C. Mossman, of the Argentine Meteorological Office, makes an addition to his third article on southern hemisphere seasonal correlations (NATURE, July 17), showing that a relation can be traced between rainfall at Malden Island (South Pacific) and mean temperature at Punta Arenas (Magellan Strait) from May to August. When the rainfall at Malden Island is above the average the temperature at Punta Arenas is below the normal, and *vice versâ*. During the seventeen years 1890–1906 there are only two years, 1894 and 1904, in which the signs are the same, but in each of the four years 1907–10 a low mean temperature at Punta Arenas is associated with a deficient rainfall at Malden Island during the four months in question. Dr. Hildebrandsson has shown that an apparently well-established correlation may break down for a few years, and Mr. Mossman remarks that the case under discussion offers another instance of the snapping of the chain.

A MEMORANDUM on the meteorological conditions prevailing over various parts of the earth before the advance of the south-west monsoon in India, issued by the Director-General of Observatories on June 8, has been recently received. The distribution of pressure is most favourable when the latter is high in March, April, and May in Argentina and Chile, and low in May in the Indian Ocean; on the whole the general pressure conditions appear slightly unfavourable. The inferences to be drawn from the winds and rainfall in the Indian Ocean during the previous two months do not affect the present monsoon prospects very strongly, while the accumulations of snowfall lying on the hills are probably normal. Although no explanation is forthcoming, there is apparently a tendency for years of which the average pressure over India is high to be associated with a good monsoon in the succeeding year, and *vice versâ*; in 1912 pressure was in moderate excess, and the tendency therefore affords grounds for hope. From these indications all that can be inferred is that a large excess or defect in the total monsoon rainfall of India is unlikely.

THE electron theory makes the dielectric constant k of an electrical insulator vary so that $(k-1)/(k+2)$ is proportional to the density. Temperature, therefore, which has little effect on the density, should have little on the dielectric constant. Measurement has shown, on the other hand, that the effect of temperature on the constant is considerable, and Prof. Debye, of Zürich, recently suggested that this effect could be explained by the presence of electrical doublets in the dielectric so long as it is in the liquid state. The product of the absolute temperature into the expression above should then be a linear function of the absolute temperature. This Debye showed to be the case. In the *Verhandlungen* of the German Physical Society for June 30, Dr. Ratnowsky, of Zürich, shows that the dielectric constant should in these circumstances depend to a small extent on the electric field to which the insulator is subjected. A series of measurements by him on a solution of amyl alcohol in benzol made by the alternating-current bridge method has confirmed this deduction and gives the number of doublets per cubic centimetre and their electrical moment in fair agreement with the values found by Debye.

WE have received vol. vi. of the Journal of the Municipal School of Technology, Manchester, which consists of a reprint of the scientific and technical papers which have been communicated to societies or published in the technical Press by members of the staff or by students of the school during the year 1912. Nineteen such papers cover the 267 pages of the journal, and deal with subjects like the investigation of the best form and speed for durability of cutting tools, the forces which produce corrugation of tram rails, the properties of porcelain insulators used in high-tension electrical power transmission, the influence of alkalis in the dyeing of cotton, the action of metallic chlorides in sizing cotton yarn, the action of light on colouring matters. We know of no other technical school in this country which can show so valuable a series of researches turned out in a single year, and we wish the Manchester School every success in its avowed intention, by offering "systematic training in the principles of science and art as applied to industry," of producing "men of character, wide knowledge, and practical experience," and so fostering industry.

THE Optical Convention held at South Kensington on June 19–26 of last year was described in an article published in the issue of NATURE for June 27, 1912

(vol. lxxxix., p. 435). The Proceedings of the convention have now been published for the University of London Press, Ltd., by Messrs. Hodder and Stoughton. The handsome volume runs to 359 large pages, and contains the inaugural address of the president, Prof. S. P. Thompson—extracts from which were published in NATURE of the date mentioned—and the papers read at the convention. The papers are chiefly of a technical description, largely directed to the issues of technical inquiry, and a few are devoted to the details of manufacture. Among the contents of the volume of more general interest may be mentioned the report of Prof. Turner's lecture on the great observatories of America, and Prof. Stirling's popular lecture on optical illusions. A table of constants for calculating spherical aberration forms an appendix; this comprises a selection of logarithms of use in some of the more laborious calculations which the designers of lens combinations have to make. The price of the volume is 10s. net.

THE National Academy of Sciences of the United States of America was founded in 1863, and 1913 sees completed the fiftieth year of its existence. It was decided in 1909 to have prepared for publication, in connection with this semi-centenary of the academy, a volume containing as complete an historical summary as could be brought together in the time available. A committee was appointed to take charge of the matter, and in the summer of 1910 the services of Dr. F. W. True were secured as editor. The result of the labours of this committee is seen in the "History of the First Half-Century of the National Academy of Sciences, 1863–1913," a copy of which has reached us from Washington. It was hoped that a list of the scientific communications presented to the academy since its foundation, some two thousand in number, might be added to the volume, but it has been found impossible in the time available to compile the necessary data. The completion of the undertaking is deferred until a later date. The present handsome volume runs to some 400 large pages, and gives exhaustive information as to the founding of the academy, its annals, and its work as scientific adviser of the U.S. Government. Biographical sketches of the incorporators of the academy add interest to the work, while the numerous appendices provide most useful lists of members, medallists, officers, and so on.

MR. FRANCIS EDWARDS, 83 High Street, Marylebone, London, W., has published the August issue of his catalogue of second-hand books in all classes of literature. The volumes listed include a number from the library of Mr. Thomas Pennant, the antiquary and naturalist.

OUR ASTRONOMICAL COLUMN.

AUGUST METEORS.—The most interesting and important season of the year for meteoric work has now arrived. The Perseids return regularly in August, and always repay observation, though there are marked variations in their annual displays.

During the last few years this shower has scarcely justified expectation, but the conditions have not been very favourable. At the ensuing return possibly the meteors may return in their old-time abundance, but there will be a little interference from moonlight before midnight. This need not, however, materially affect the character of the display, for on the nights of August 11 and 12, when the maximum will occur, our satellite will be only just past the first quarter, and will set on August 11 at 11h. 13m., and August 12 at 12h. 9m. p.m.

It seems desirable to watch the phenomenon closely every year for several reasons. Its period is not yet exactly ascertained, and we are not sufficiently well acquainted with its annual variations. The hourly number of meteors visible should be determined, and the time of their maximum abundance. It is also important to record the apparent paths of such brilliant meteors as may be visible.

In the case of fireballs the lingering streaks give evidence of rapid currents in the upper atmosphere, and should be specially watched. It will be useful to note the position of the streaks amongst the stars and to record the rate and direction of their drift, at short intervals, during the period of their visibility. The streaks are usually from sixty-five to fifty-five miles in height.

Directly a streak is seen a telescope or field-glass should be directed towards it. A streak which remains visible to the naked eye a few seconds can sometimes be watched for five or ten minutes with a glass.

It is astonishing how many of the meteors of the August stream are destroyed every year by collision with the earth's atmosphere. Basing calculations on observed facts, it is probable that between 80 and 100 millions of these meteors are encountered every year. This great annual expenditure might be thought to have a perceptible effect in diminishing the visible numbers, but when we remember that Prof. H. A. Newton computed the number of meteors in the August system as 300,000,000,000,000, it is certain that any apparent falling off in the richness of the shower would only become sensible after many thousands of years.

DISPLACEMENT OF SPECTRUM LINES OF METALS DUE TO IMPURITIES.—An important piece of research work, chiefly interesting to spectroscopists, is that recently communicated by M. Keivin Burns to the *Comptes rendus* for June 30 (vol. clvi., No. 26, p. 1976). M. Burns finds that the presence of a large proportion of luminous vapour in an arc of iron or mercury displaces the spectrum lines of those metals contained in a small proportion in the arc (such as barium, manganese, cadmium) in relation to the positions they would occupy if the metals which produced them were predominant. He suggests that this displacement may be the result of numerous particles in a special condition where they emit light and not of ordinary molecules or atoms; the displacement is not explained by a pressure effect. He points out that the existence of this displacement does not render it prudent to use such lines of impurities as standards in attributing the wave-lengths found from measures made under other conditions.

CIRCULATION IN THE SOLAR ATMOSPHERE.—Anyone who has closely studied a number of photographs of solar prominences photographed on the limb of the sun would have the idea of solar currents brought to his mind.

A systematic study of a large number of such photographs becomes therefore of extreme interest from the solar circulation point of view, and such a study has been undertaken by Prof. Slocum, of the Yerkes Observatory, from spectroheliograph photographs he has taken with the large Yerkes refractor. His second

paper on the subject appears in *The Astrophysical Journal* (June, vol. xxxvii., No. 5), and the conclusions at which he arrives can be best conveyed in his own concise summary. Many prominences, by their shapes or movements, seem to indicate the existence of a horizontal current in the solar atmosphere. This current may have opposite directions at different altitudes in the same locality. It may change its direction, just as the wind changes upon the earth. In middle latitudes the average tendency for movement is towards the poles. In high latitudes the tendency is towards the equator. This tendency is more marked in the northern than southern hemisphere. From lat. 10° N. to 10° S. the average tendency is from north to south directly across the equator. The prevailing directions mentioned above apply to prominences of all heights.

THE BRIGHTON MEETING OF THE BRITISH MEDICAL ASSOCIATION.

A MEDICAL congress, especially in view of the wide development of specialism, rarely if ever helps to bring to light a new discovery or to promote a new theory, or at least to work out an application in practice of some basic theoretic facts. It has, however, the importance of grouping together men who work on widely different lines and are enabled to exchange ideas in a favourable atmosphere. In so far the Brighton meeting of the British Medical Association was undoubtedly very successful. We had, for example, a very interesting address by Prof. C. G. Barkla, F.R.S., on the secondary X-ray radiations in medicine, which, being delivered by a prominent physicist, introduced an element of exact science into empiricism of therapeutic applications. Prof. Barkla gave a detailed description of the scattered, fluorescent, and corpuscular rays. He reminded his audience that all chemical, therapeutic, and physical action attributed to X-rays was due to the secondary radiation of negative electrons. He pointed out that in order to produce a definite effect in an organ there must be a transformation of the energy of Röntgen radiation into energy of corpuscular radiation, as well as an absorption of the latter by the respective organ.

The solid basis and irrefutable arguments of physics could not be found or expected in the discussion on anaphylaxis. This was opened by Prof. W. E. Dixon, who entered into various details of the condition of experimentally produced hypersensitiveness, describing the changes occurring in the muscular and circulatory systems, and emphasising the significance of local symptoms. When he came to declare his preference for one of the three leading hypotheses as to the causation of the "anaphylactic shock," he declared himself in favour of the ferment theory, because he regarded the "classical" side-chain theory as a purely speculative hypothesis, and the more recent "colloidal theory" as still being in its infancy, whereas he found the ferment theory to be based on carefully recorded physiological facts. Prof. G. Sims Woodhead and Dr. Myers Coplans gave examples of clinical conditions which may be looked upon as similar to that of experimental anaphylaxis. Prof. Woodhead made a very interesting remark as to the possibility of explaining some of the phases of pneumonia by the sensitisation of the system by the specific bacterial protein. He also referred to the view largely held as to the possibility of organs being specifically sensitised, as instanced by the uterine muscle in eclampsia.

Drs. Embleton and Thiele related the results of their very remarkable experiments, which have shown that by sensitising laboratory animals by injection of bacterial protein of purely saprophytic bacteria like *B. mesentericus* one may make them so highly susceptible that a subsequent inoculation of live bacteria of the same species will kill the animals under symptoms of acute septicæmia. These experiments are undoubtedly of a very wide importance, as they may help in producing typical specific disease conditions in experimental animals naturally refractive to the infection produced by ordinary means.

A less debatable basis for discussion was given by Prof. George R. Murray, who dwelt on the importance of internal secretion in disease in a masterly presidential address. He explicitly limited the name of "secretion" to the useful products of glandular activity which pass into the blood stream in order to play some definite part in metabolism. Ductless glands in particular act on other tissues by means of "hormones," which excite definite forms of chemical activity in cells for which they have a special affinity. The glandular cells may form more than one specific hormone; they may also produce "inhibitory hormones," *i.e.* substances which inhibit the chemical activity of the tissue cells instead of exciting them. He passed in review the consequences of an insufficient as well as superabundant supply of glandular hormones, and insisted particularly on the relations of the thyroid and pancreatic gland which tend to inhibit each other. This, as proved by further discussion, is one of the most important facts for the practice, as it tends to explain the machinery of diabetes and all forms of glycosuria. Dr. A. E. Garrod, F.R.S., could not discover any basis for a sharp differentiation of the diabetic and non-diabetic glycosurias. In his belief the progress of research was strengthening the viewpoint that the internal secretion of pancreas was the almost only controller of carbohydrate metabolism in the system. The peculiar forms of glycosuria without a definite diseased condition he tried to explain by a disturbed correlation between the various glands of internal secretion.

A general impression gained from all the various discussions can be summarised in that the medical profession is fully alive to the importance of "control" experiments, that it errs rather in the application of a severe criticism to its scientific contributions, and keeps to the moral, "Prove all things, holding fast that which is good."

HYDROGRAPHIC AND PLANKTON OBSERVATIONS IN THE NORTH SEA.

WE have received from the Board of Agriculture and Fisheries the subjoined communication relating to observations to be made in the North Sea :—

The research vessel s.y. *Hiawatha*, chartered for fishery research in the North Sea, left the Tyne on Tuesday for the purpose of making certain practically continuous hydrographic observations, at a fixed position during the first fortnight of August. She will be taking part in a coordinated research into the movements of the great water masses in the North Sea, and for this purpose she will drop her anchor about 150 miles "E. by N. ½ N." of Shields and commence her work. Her labours will be identical in aim and in the main in methods with researches simultaneously carried out on board eight other vessels, also at anchor, at positions which collectively will permit of the study of conditions representative of the hydrographic conditions over the whole of the North Sea.

Two of these other vessels will be research vessels, acting on behalf of Sweden and Scotland, the Swedish vessel working in the Skagerak, the Scottish well to

the north-east of Aberdeen. The remaining vessels are light vessels, two acting for Holland, the other four, by courtesy of the Brethren of the Trinity, for the English department.

The observations will consist of current measurements made near both surface and bottom every hour night and day, throughout the fortnight, and in fine weather at other intermediate depths. Special attention will be paid to the submarine waves which are, it is expected, to be met with at the depth at which the heavier bottom water and the lighter surface water are in contact; but information will be obtained as to all layers. Specially devised current meters are used in this work, some depending for their operation on small propellers, resembling those of an anemometer and worked by the current, others upon the deflection of a wire from which a metal cylinder depends, caused by the force exerted by the current. The temperature and salinity of the various layers of the sea will also be ascertained in the course of the work, special water-bottles being employed to secure samples of the sea from any desired depth. Samples of the minute floating organisms which, directly or indirectly, constitute the food of all our food fishes will also be taken at various depths and at the extremes of the tide.

Some idea of the scale of the operations may be gathered by the fact that it is expected that some 8000 independent current measurements will be made from the English vessels alone.

The hydrographic operations are planned by a special committee of the International Council for the Exploration of the Sea. They are undertaken because a knowledge of the constitution and movements of the sea-water is essential to the understanding of the movements and even of the abundance of the fishes upon which our fishing industry depends. As a classical instance, the herring of the Kattegat and Skagerak may be cited. Its abundance or scarcity has been found to be connected directly with the amount of water which enters the Baltic from the North Sea; and, indeed, not only the herring fishery but other fisheries of southern Sweden have been shown to change with the ebb and flow of this layer of cold salt water. It is clear, in fact, that a state of knowledge of marine currents which would permit of prognostication as to their movements and volume at a later period would in the case of many fisheries permit the fishermen to reap the utmost harvest which the year would afford or to anticipate a time of scarcity and take such precautions as were possible to mitigate its effects.

A NEW METHOD OF COOLING GAS-ENGINES.

THE summer meeting of the Institution of Mechanical Engineers was held in Cambridge last week. Among the many papers read and discussed, that by Prof. Bertram Hopkinson, of Cambridge University, takes a prominent place; the subject of the paper was a new method of cooling gas-engines. The most important peculiarity of the gas-engine, that which determines the characteristic features of its design and operation, is the heat-flow from the hot gases into the cylinder walls. About 30 per cent. of the heating value of the fuel passes into the metal of the engine in this way. The method hitherto employed in removing this heat has been by the circulation of water in jackets, except in the case of small air-cooled engines. In large engines, the piston and exhaust valve have also been kept cool by circulation of water. The appliances necessary for the carrying out of this method have been responsible largely for the great weight and cost of large gas-engines.

Water circulation has secondary effects which tend to make a large engine untrustworthy in working. The cylinder walls in places may be 3 in. thick or more. To cause the heat to flow from the inner to the outer surface of the metal requires a temperature difference of the order of 50° C. per inch, and this may become serious with thick walls. It is also difficult in large engines to secure adequate circulation about all parts of the cylinder walls and piston, and some parts may be much hotter than others. Severe stresses may be set up in consequence of the unequal expansion, and the overheating of certain parts of the inner surface is apt to cause pre-ignition of the charge. In consequence of the dangers of overheating it has been found impossible to work gas-engines, especially of large size, continuously at the maximum power which they can develop.

In Prof. Hopkinson's method of cooling, water is injected internally in thin jets directed against the walls of the combustion chamber and the end of the piston. There is thus no heat flow through the metal and no difference of temperature between the inner and outer surfaces. The water is so distributed that each part receives it in proportion to the rate at which it receives heat from the hot gases. Practically uniform temperature all over is thus maintained, and the stresses due to unequal heating are eliminated. A simple single-walled casting can be used for the cylinder, resulting in a great saving in weight and cost and in improved trustworthiness on account of the elimination of casting stresses. Piston-cooling arrangements—a frequent cause of trouble—can be dispensed with. Finally, pre-ignitions are entirely prevented.

To obtain success in this method of cooling, the water must be projected in comparatively coarse drops or jets directly against the surfaces to be cooled, so that it reaches these surfaces in the liquid form without much loss by evaporation on the way. Water which reaches the walls in the liquid form, and is there evaporated, absorbs, out of the heat given to the walls by the gas, the *whole* of its own heat of evaporation; there is no loss of thermodynamic efficiency because the heat used is waste heat, which in a jacketed engine would go to warm the cooling water. Any steam formed in this way is pure gain; and, if anything, there is an increase in the work done.

Further, if the cylinder walls are allowed to become and remain wet, they are destroyed rapidly by corrosion. This is due to the presence of sulphur dioxide in the gas, which forms sulphurous acid when dissolved in water. This difficulty has been overcome by regulating the amount of water injected in such a way that the temperature of the whole of the engine is kept well above 100° C. Under these conditions every drop of injected water is boiled when it reaches the walls, and no liquid can accumulate. It is found to be sufficient to inject water on to the surface of the combustion-chamber and the head of the piston only; the cooling of the barrel is effected by conduction into the piston. Thus no water falls on the sliding surfaces, where it would cause damage by the dissolved salts producing grinding.

Trials have been made on a Crossley engine fitted with a new cylinder embodying the principles explained above. The cylinder is 11½ in. diameter by 21 in. stroke, and is rated at 40 brake horse-power at 180 revolutions per minute. The success of this engine, as compared with the original water-jacketed cylinder, has been remarkable. After considerable preliminary trials, the engine was put to drive a dynamo in a

factory engine-room, at a speed increased to 195 revolutions per minute. It developed frequently 50 brake horse-power with coal gas for several hours together. Since then the engine has been taken to Cambridge, and is now engaged in regular service with a suction-producer, driving the workshops, and producing electric current for the engineering laboratory. It is left to itself like an ordinary gas-engine, giving no trouble at all, and has been in regular work for two years, the total time of running being 5000 hours.

Judging from the success which has so far been obtained, it seems likely that Prof. Hopkinson's method of cooling the cylinder will revolutionise the design and construction of large gas-engine cylinders.

RECENT PAPERS ON VERTEBRATE PALÆONTOLOGY.

A VERY remarkable announcement is made by Mr. J. W. Gidley in vol. lx., No. 27, of the Smithsonian Miscellaneous Collections, namely that an associated series of five upper cheek-teeth of a large ruminant from a Pleistocene cave-deposit near Cumberland, Maryland, U.S.A., indicate an antelope apparently closely related to the elands of Africa. So near, indeed, is the resemblance that the author deems himself justified in referring the fossil to the existing genus, under the name of *Taurotragus americanus*; and the plate showing these teeth alongside those of the existing *T. oryx* goes a long way in confirming his conclusion. It should have been mentioned that the present writer (see Cat. Siwalik Vert. Ind. Mus., part i., p. 1885) has provisionally referred certain teeth from the Indian Siwaliks to Taurotragus (=Oreas); and if the identification be correct, it would explain how eland might have reached America from Asia by the Bering Sea route. Mr. Gidley quotes the occurrence in the Pleistocene of Nevada of remains of certain ruminants described as Ilingoceros and Sphenophalus as corroborative evidence of the former existtence of tragelaphine antelopes in America; but he omits to mention that although these genera were at first assigned to that group, they have been subsequently regarded as akin to the American family Antilocapridæ (Merriam, Bull. Dept. Geol. Univ. California, vol. vi., p. 292). If this be correct, is it quite impossible that the supposed eland represents another member of the same group?

In a second communication (*op cit.*, No. 26) Mr. Gidley records the occurrence of a toe-bone of a camel in a superficial deposit at the mouth of Old Crow River, in the Yukon Territory, in association with remains of mammoth, horse, and bison. The occurrence of the camel-bone confirms "the theory of the existence of a wide Asiatic-Alaskan land connection of comparatively recent date, which for a very considerable length of time served as a great highway for the free transmission of mammals between America and the Old World."

As being only in part palæontological, brief notice must suffice for a paper, by Mr. K. S. Bardenfleth, on the form of the carnassial tooth in Carnivora, published in *Vidensk. Meddel. Dansk. naturh. Foren*, vol. lxv., pp. 67–111. After reviewing the various theories of the homology of tooth-cusps, the author proceeds to observe that in order to demonstrate that the simple reptilian tooth-cone is represented by the middle one of the three longitudinally arranged cusps of the Purbeck Triconodon, and that the tritubercular crown has been formed by rotation of the other two, indisputable evidence has yet to be furnished, "first, of the Triconodon-like forms being the ancestors of Dryolestes, &c.; second, of the supposed protocone and protoconid of these being really homologous with the median cusp of Triconodon. One can scarcely imagine how such a rotation could take place, and if Gidley is right in his interpretation of the molar cusps of Dryolestes, the rotation has not taken place, but the so-called protocone is a secondary acquirement; the true protocone is still to be sought in the central one of the three outer cusps. If this holds good the whole nomenclature and theory of Osborn falls to the ground; neither protocone nor protoconid are then identical with the reptilian cone."

Three papers, by Dr. R. Broom, form part 6 of vol. vii. of the Annals of the South African Museum, and relate to the extinct reptiles of the same country. In the first of the triad the author shows that while in Pariasaurus the digital formula is 2.3.3.4.3, in the allied Propappus it is probably 2.3.4.5.3. In the second he describes, as *Noteosaurus africanus*, a new genus allied to Mesosaurus, of which three of the known species are South African, while the fourth is Brazilian. The last paper comprises a classified list of the early Mesozoic reptiles of South Africa, which, apart from dinosaurs, crocodiles, rhynchocephalians, &c., are arranged in no fewer than nine ordinal groups, brigaded in three "superorders." R. L.

AN ALGEBRA FOR PHYSICISTS.[1]

THE principal novelties in Dr. Macfarlane's calculus are that a distinction is made between linear and cyclic successions of vectors, and that the commutative law of addition, as well as that of multiplication, is abandoned. To express what most vectorists write $\beta+\alpha=\alpha+\beta$, Dr. Macfarlane writes $\Sigma(\beta+\alpha)=\Sigma(\alpha+\beta)$. Thus $\alpha+\beta-\alpha$ is not the same as β, but either three sides of a parallelogram, or three coinitial vectors, according as we take linear or cyclical succession. By introducing some subsidiary and rather artificial rules, the author is able to get formulæ that are, in appearance, analogous to the binomial and exponential theorems, and so on.

The actual divergence from quaternion results is not very great, as may be easily shown by an example. Let x be a scalar, α a unit vector, and let $\exp(x\alpha)$ be defined to mean $\Sigma(x\alpha)^n/n!$. Then $\exp(x\alpha)=\cos x+\alpha\sin x$, and if y is another scalar, $\exp(x\alpha).\exp(y\alpha)=\exp(y\alpha)\exp(x\alpha)=\exp\{(x+y)\alpha\}=\cos(x+y)+\alpha\sin(x+y)$.

But, if β is another unit vector,

$$\exp(x\alpha)\exp(y\beta)=\cos x\cos y+\alpha\sin x\cos y+\beta\cos x\sin y+\alpha\beta\sin x\sin y,$$

which differs from $\exp(y\beta).\exp(x\alpha)$, while both, in general, differ from $\exp(x\alpha+y\beta)$: the latter, observe, being by definition the same as $\exp(y\beta+x\alpha)$. Dr. Macfarlane, after writing down his exponential formula, breaks it up into four parts, practically the same as the four given by the quaternion formula above, when written in the form—

$$\exp(x\alpha)\exp(y\beta)=(\cos x\cos y+\sin x\sin y\,S\alpha\beta)+\alpha\sin x\cos y+\beta\cos x\sin y+V\alpha\beta.\sin x\sin y.$$

It must be left to physicists themselves to decide whether Dr. Macfarlane's new algebra is superior to those already available; the need of a sign to express a resultant is a rather severe handicap. To the pure analyst it presents the appearance of a conglomerate, though possibly, with a change of notation, it could be fitted into a place in the family of linear associative algebras. One thing ought to be said: it is not, properly speaking, an "extension" of quaternions. Analytically, the calculus of quaternions is a linear algebra of a perfectly definite type,

[1] (1) "Account of Researches in the Algebra of Physics," I.–III. (Reprint from Journ. Wash. Ac. of Sc., 1912.)
(2) "On Vector-analysis as Generalised Algebra" (Intern. Congress of Mathematicians, 1912.) By Dr. A. Macfarlane.

just as an oak is a perfectly definite type of a tree. Taking $q=x+yi+zj+wk$ as the type of a quaternion, we may generalise the "scalars" x, y, z, w, by making them ordinary complex numbers, or elements of some other algebra, commutative with i, j, k, and combining according to laws of their own. We thus embed the quaternion algebra, so to speak, in a larger composite algebra; but it is most undesirable to call this an extension, still less a completion, of quaternions.

The reader should be warned that the author often says "must" when there is no logical necessity at all. For instance, we are told that, β having one dimension in length, β^2 "must" have two; yet on the next page we are told that $\alpha\beta\gamma\delta$ means a solid angle, thus apparently having no dimensions in length, at any rate not four. This kind of fogginess is very common, even among quaternionists. Thus $ij=k$, so the product of two vectors can be a vector, and the law of dimensions is violated, or rather does not apply. Of course, in physics, it is convenient to represent areas, moments, &c., by vectors, and then the quaternion formulæ become more significant. We might, if we liked, put $ij=k_2$, $jk=i_2$, $ki=j_2$, regarding i_2, j_2, k_2 as areal units, and then have what Grassmann would call a regressive multiplication, $i_2j_2=k$, $j_2k_2=i$, $k_2i_2=j$, bringing us back to one dimension again. But anyone can see that this is unnecessary complication; in all physical applications of quaternions it is easy to see whether a vector is to be interpreted literally, or as the representative of some areal quantity.

Whatever may be the ultimate fate of this particular algebra, Dr. Macfarlane's researches deserve recognition. He has the spirit and the courage of a heretic, and every honest heretic helps to advance the truth.

G. B. M.

UNITED STATES METEOROLOGICAL PUBLICATIONS.[1]

(1) THE first thirty pages of the report of the Chief of the Weather Bureau for the year 1911–12 contain a summary of the work accomplished by that department during the year. This is followed by a general statement of the weather conditions prevailing in the individual months, while the last and by far the longest part of the report is devoted to tabulated statistics of the different meteorological elements with summaries of sunshine, excessive rainfall, &c.

An account of the work done at the upper-air station on Mount Weather is given first place in the volume, and from this we learn that it is proposed to modify the plan hitherto followed of attempting to obtain a kite or balloon flight on each day, regardless of the weather conditions, and to substitute a series of special ascents made to investigate particular problems. It is interesting to learn that a special department is being inaugurated at this observatory for the training of observers for duty at the 200 out-stations of the weather service. At the central office a synoptic weather chart is prepared each day for the whole of the northern hemisphere, and on this map are based general forecasts of the weather and temperature conditions over the United States for a week in advance. It is intended shortly to institute a service of wireless reports from ships in the Atlantic, and to transmit information as to the location and movements of dangerous storms to vessels from one of the high-power stations on the coast. Extensive observations are now being made on the snowfall of the western mountain ranges, and it is hoped to be able in the future to give useful forecasts of the flow of those rivers which are fed in the spring and summer by the thawing snow. A feature of the report is the list of new books added to the library during the year. Many of the more important of these works are referred to individually, and a short account is given of the scope covered by each book. This should prove useful for purposes of reference. It is evident from a perusal of the volume that the operations of the bureau are conducted on a very large scale, as befits an institution dealing with meteorological information from an area like that of the United States.

(2) The impending opening of the Panama Canal renders the subject of the second paper of especial importance at the present time. In addition to dealing with the West Indian hurricanes, the author sets out comparative data for the typhoons of the Pacific and the cyclones of the Bay of Bengal. All these disturbances are of the same type, characterised by a moderate decrease of atmospheric pressure to within forty or fifty miles of the centre, and then the rapid fall associated with the destructive winds which cause such havoc in the belt passed over by the central region of the disturbance. Nearly all the West Indian hurricanes have their origin in a well-marked area bounded by the parallels of 12° and 26° N. latitude, and lying between 56° and 90° W. longitude. The typical track is parabolic in shape, the storm moving W.N.W. at first, then curving round to the N., and finally passing in a north-easterly direction to the North Atlantic. The average rate of travel of these storms is only 300 miles per day, so that the forecaster is often enabled to give a fairly long warning of their approach. Much useful information is contained in the paper, and Dr. Fassig is to be congratulated on the completion of a trustworthy piece of work.

J. S. D.

[1] (1) Report of the Chief of the Weather Bureau, 1911–12.
(2) Hurricanes of the West Indies, Dr. O. L. Fassig.

REFLECTION AS A CONCEALING AND REVEALING FACTOR IN AQUATIC AND SUBAQUATIC LIFE.[1]

AS a result of observations and experiments carried out on ponds built for the purpose, and by the use of apparatus for observing organisms in their natural environments, I have arrived at certain conclusions as to the value of reflection as a concealing factor in various forms of aquatic and subaquatic life. The general principle upon which these ponds are built is as follows:—In one bank of the pond is a glass window, and beyond this window an underground observation chamber. No light enters this chamber except through the surface of the water. By this means everything in the pond is seen by *entirely* natural illumination, the observer cannot be detected, and as there is no reflection from the glass the making of photographic records is greatly simplified. In the first pond, built for the observation of objects in the water, the glass is perpendicular. In the second, for observing objects on the surface, the glass is at an angle of 45° to the surface.

Of apparatus I use a tube 18 in. square and 5 ft. long. On one side at the lower end is a window; into this tube slides a reflex camera, so that the lens is opposite the glass. When in use, a heavy weight carrying a hook is lowered into the water, with the end of the tube attached to the hook. The whole apparatus can be tilted at any angle, and by this means the incident rays from any object in any position—except overhead—are made to strike the glass at right angles, and thus distortion, due to refraction through the glass, is rendered negligible.

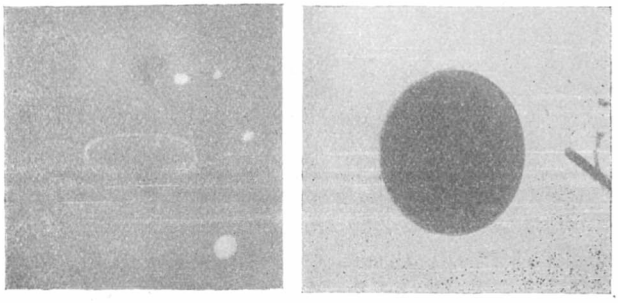
[1] Discourse delivered at the Royal Institution on Friday, June 6, by Dr. Francis Ward.

The apparatus has been mainly used as a check upon observations in the ponds.

For observing and photographing life on the bottom, I use a tube 3 ft. long, with a glass partition inside, a foot from the end. This apparatus acts as a boat-like sea telescope, and is fitted with a camera. Lastly, through the kindness of Prof. Herdman, I have established at Port Erin a large wooden tank above ground. Three sides of the tank incline at an angle of 45°; the fourth is perpendicular. In the perpendicular side is a glass window, and attached to it an observation box, 6 ft. by 4 ft. The tank and observation box revolve together on a platform; by this means an object in the tank can be seen by reflected and transmitted light at will.

It is usual to consider pigmentation as the main factor in the concealment of subaquatic life. Among organisms that live in more or less the same character of surroundings, pigmentation is undoubtedly most important; but in the forms of life that are constantly changing their environments, the best concealed are those that most effectively reflect their surroundings.

When, however, an organism depends mainly upon reflection for its concealment, the reflection of light from above has to be modified, or else the organism is revealed. In some forms of life, particularly fishes, pigmentation upon the back is the method of modifying this reflection from above. In other forms this top light is cut off by position, *e.g.* in light-coloured



White saucer on the surface in the area of total reflection. White saucer on the surface in the circle of light.

FIG. 1.

anemones, which are only to be found attached to the under-surface of shelving rocks.

Before proceeding further, I would like to illustrate the appearance of a white object, as seen from under the water. I show a sheet of white cardboard pinned on a red stick, which in turn was stuck in the centre of an *empty* pond. The sides and bottom of the pond were covered with green confervæ. In this position the card appeared white, and incidentally the stick red.

The pond was then filled up with water, and now the white card so exactly reflected the colour around that it became practically invisible, yet its position was revealed by a streak of light along the upper edge of the card.

In nature all white subaquatic organisms reflect in a similar manner, and white is never seen under the water, except when there is no provision made for modifying the reflection of light from above, or when the organism turns on its side.

As an illustration of this point, let us consider the white anemone (*Actinoloba dianthus*). I show a colour-plate of this anemone attached to the top of a rock and, of course, it appears white, but as soon as it moved only a distance of 2 in. under the shelving edge of the rock, the top light was cut off, and you will see the white anemone appears green as it reflected the prevailing colour below.

It will be noticed that the white serpula on the rock reflects in the same manner; and as the light parts of rock also appear of a greenish colour the anemone and the serpula are practically invisible. Advisedly I say practically invisible, for the greenish anemone when closed makes a uniformly shaded green mass against a patterned rock.

It will have been noticed that the red stick holding the white card, when seen from under the water in green surroundings, appeared a dull black.

When *Tealia crassicornis* (a red and white anemone) is attached to the under-surface of a rock with a green coloration below, the whites of this anemone appear green and the red markings appear dark, so that now the anemone shows a general green coloration with dark markings upon it, which fit in with the dark markings on the stone. Many forms of light-coloured marine life are found under shelving rocks. I consider they escape destruction in this position owing to the fact that they reflect their surroundings.

Next let us consider the modification of reflection by pigmentation. This is best illustrated in fishes. Until one has observed fish by *entirely* natural illumination, it is difficult to realise how important a

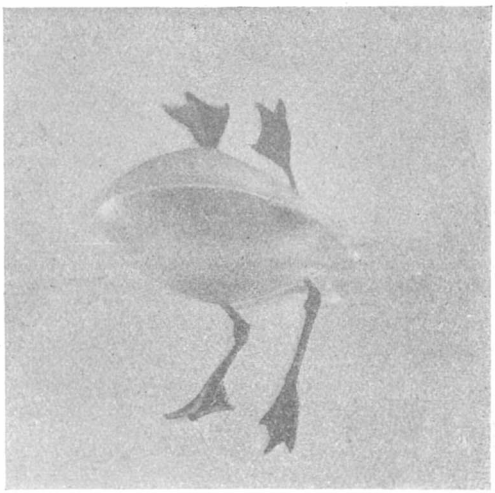


FIG. 2.—Lesser black-backed gull on surface in area of total reflection. (From life.)

part reflection plays in rendering both silvery and highly pigmented fishes inconspicuous.

The silvery fish does not appear silvery, but red, brown, or green, according to the general colour around, and in addition it will reflect upon its body stem for stem the reeds into which it has rushed in order to hide itself.

As an illustration to show how a highly pigmented fish reflects light, I show a tench, only 6 in. under the water, and it will be seen the dark back appears quite silvery.

Pigmentation on the back conceals a fish against the bottom, but undoubtedly the important function is to conceal it, for protective and aggressive purposes, from other fish on the same level as itself. I would point out that the same light which is reflected from the sides of the fish, through the eye of the fish, controls the amount of contraction of the pigment cells on the back: thus the reflection from above is correctly modified, and the fish is rendered a uniform shade. But this uniform shade only conceals against a uniform background.

Thayer has shown in the animal world how the

counter-shaded bird, or beast, without markings, when seen against a patterned background, becomes conspicuous, because it interrupts the pattern. The same is seen in the fish world, and in illustration I would direct your attention to the appearance of a perch (*Perca fluviatilis*) swimming past a reed bed.

In the autochrome of a brown trout lying under a stepping-stone, I show the value of reflection; here, the back green, and the belly red, as they reflect the stones above and below, are undoubtedly the main factors in concealing this fish, and the markings simply prevent the body from appearing patternless.

I would next direct your attention to the possible influence of reflection of light, from some forms of marine vegetation, upon the pigmentation of various marine organisms. Several red and brown seaweeds seen by transmitted light appear red and brown, but when seen against a dark background they reflect at various points a brilliant bluish-purple colour. Chondrus shows this well. In certain positions the whole side of a dark rock, covered with red and brown seaweed, shows blotches and streaks of bluish-purple. This is well marked upon the concrete blocks on the old breakwater at Port Erin.

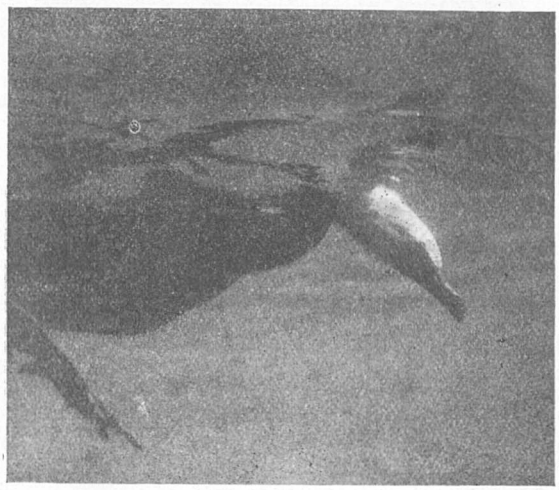


FIG. 3.—Cormorant on surface dipping head under water. (From life.)

Lobsters, crabs, and many other forms of marine life, usually found in crevices among dark rocks covered with red and brown seaweeds, show a pigmentation exactly similar in appearance to the colour reflected from the seaweed. This is particularly well marked in the swimming crab, *Portunus puber*.

I would now refer to the appearance of life on the surface, as seen from below. This appearance entirely depends upon the position that the particular organism occupies on the surface, relatively to the point of observation from below the water.

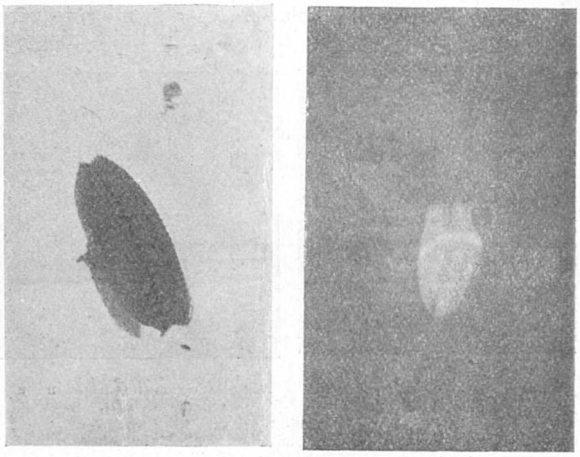
On looking up to the surface, an observer sees above him a circle of light, through which he can see the sky and clouds. Beyond this circle there is total reflection, and the surface of the water reflects the general colour below. Transparent organisms are practically invisible, both in the circle of light and beyond. Now it is generally understood that forms of life that occasionally or habitually float on the surface are white underneath, so as to conceal them against the clouds and wave foam.

In dealing with this subject it is necessary to make a difference between white organisms that are opaque and those that are translucent. Commencing with the opaque, I will illustrate the point with the appearance of a thick white saucer. This was floated from some distance over my head. Outside the circle of light the surface of the water was reflecting the green bottom of the pond, the white saucer did the same, and, therefore, was invisible against the surface of the water. When, however, it came into the circle of light it still reflected the dark colour below and was revealed as a well-defined dark object against the sky and clouds.

A white-breasted gull swimming on the surface is concealed and revealed in an exactly similar manner. Therefore, an opaque white organism in the circle of light is not concealed, and when seen against the clouds the whiter the object the more conspicuous it becomes, because it reflects the dark water below. A white object is, however, concealed by reflection in the area of total reflection.

How does this explanation affect the concealment of an opaque white object on the sea from a fish? The size of the circle of light on the surface depends entirely upon how far the fish is under the water, for lines drawn from the two ends of the diameter of the circle make an angle of 97° at the eye of the fish.

When the fish is some depth under the water there may be several white seagulls on the surface within the circle of light, but as the fish comes up to feed his circle of light is narrowed down, and the gulls slip into the area of total reflection and by reflection become invisible to the fish.



Shell of argonauta on the surface in circle of light. Shell of argonauta on the surface in area of total reflection.

FIG. 4.

For my experiments with translucent organisms I used the shell of an argonauta. In the circle of light you will see the shell is still very obvious, but as it transmitted a considerable amount of light it did not appear black like the white saucer. In the area of total reflection, however, the shell appears white, for in consequence of not being an opaque object it is no longer a reflector.

Argonauta seems to slip between two stools; it is too opaque to be concealed in the circle of light, and too translucent to be concealed in the area of total reflection. In the latter situation it certainly may be protected by simulating the appearance of wave foam, for wave foam in the area of total reflection appears as a flickering light.

So far we have only considered that portion of an object that is actually immersed. If, however, the organism under consideration is not too far distant, that portion of it above the water is visible on the

edge of the circle of light, and the parts respectively above and below appear to be separated by a considerable interval of water surface. When the portion above the water is white, as in a gull, it is difficult to detect against the sky. The above remarks only refer to open water, and I will illustrate how a wading bird is concealed against the image of a reed-bed many yards behind him. Looked at from below the markings on a heron are in bold upright lines, for the plumage is greyish-white with black patches on each side of the head, and the black patches on the shoulders appear continuous with the black primaries of the wings. Seen against an open sky, the white parts of the wading heron blend with the sky, but the black parts stand up in bold relief. The head and

1 3

2 4

1. Stuffed heron with neck straight out prepared to strike a fish.
2. Appearance of heron under the water. (From life.)
3. The same bird as he appears on the edge of the circle of light against the sky. Notice how the tree 160 ft. away and the body of the bird appear to be one.
4. Reeds were then placed 5 ft. behind the bird, and now his head and neck are not easy to detect.

When the above photographs were taken the lens of the camera was a foot below the water-level, and the heron was 4 ft. distant.

FIG. 5.

shoulders of the bird are seen on the edge of the circle of light, but so also is the reed-bed many yards behind. The reeds, seen as perpendicular images, and the perpendicular markings on the heron blend, and thus make the bird inconspicuous.

I have referred to white as a concealing agency. Black objects, when they retain air-bubbles on their surface, also become reflectors under the water. The black water-spider under a leaf appears green and is lost to sight. A waterhen swimming on the surface in the area of total reflection reflects the green weeds below, and becomes difficult to discern against the surface which is reflecting the same colour.

In conclusion, I will refer to reflection as a revealing factor. I have already illustrated this point with the anemone. I now show a slide of a shoal of young rudd wheeling round, and as they turn each fish is revealed as a flash of light as he catches the light from above.

Among diving birds the cormorant does not retain air bubbles in his feathers to the same extent as the loose-plumaged waterhen, yet by reflection he appears light or dark, according to the nature of the bottom over which he is swimming. When, however, the cormorant dives his track is marked by a series of brilliant flashes of light.

Now this bird when swimming on the surface has the habit of dropping his head under water at regular intervals—shags do the same. Seen from below, every time he does this, there is a flash of light not unlike the flash from a silvery fish turning. It is quite possible that fish, such as pollock and codling, are attracted by this flash, and thus swim towards their destroyer. These flashes of light are still better shown in the case of the penguin, and this I illustrate with individual pictures cut out of a kinematograph film.

I have had to leave the subject of refraction of light on the present occasion; first, because time does not permit of my dealing with it, and, secondly, because during the last fortnight I have tested all my experiments at Port Erin, and some of the results have made me reconsider the conclusions at which I had arrived with regard to the refraction of light in its relation to marine organisms.

TECHNICAL EDUCATION FOR INDIAN STUDENTS.

THE report of a Committee appointed by the Secretary of State for India to inquire into the system of State technical scholarships established by the Government of India in 1904, has been published as a Blue-book (Cd. 6867). On March 27, 1912, the Secretary of State appointed a Committee "to inquire and report as to the facilities available for Indian students for industrial and technological training in this country, with special reference to the system of State technical scholarships established by the Government of India in 1904." The Committee was constituted as follows:—Sir Theodore Morison, K.C.I.E. (chairman), Sir K. G. Gupta, K.C.S.I., Mr. J. H. Reynolds, Prof. W. E. Dalby, Mr. P. H. Dumbell (secretary), Mr. R. E. Field (assistant secretary). The Committee held its first meeting at the India Office on May 9, 1912, for the purpose of discussing the itinerary, and considering questions of procedure. On various occasions the Committee visited Glasgow, Leeds, Manchester, and Birmingham, where they received evidence from the higher education authorities, and visited the various laboratories, and so on, devoted to technical education. Altogether during the provincial meetings the Committee took evidence from seventy-five witnesses, of whom twenty-nine were professors and

other representatives of the universities and technical colleges, twenty-eight gentlemen intimately connected with various industries as owners and managers of works, &c., and eighteen Indian technical students.

The information laid before the Committee at the four centres visited has been sufficient to enable it to prepare a report which will indicate the main lines of the policy which should be followed, but the inquiry as to the facilities available for Indian students for industrial and technological training is by no means exhausted, and it will, the Committee thinks, be necessary—if possible, early next session—for some representative of the Secretary of State to visit such centres as Sheffield, Liverpool, Bradford, and Newcastle, where it appears probable that special facilities exist for the study of particular subjects.

Among recommendations made by the Committee the following may be mentioned:—Students sent to this country should ordinarily have read in India up to the standard of the B.Sc. or B.A. with science, or have obtained an equivalent diploma. Exceptions may, however, be made in favour of students who have an hereditary connection with the industry which they propose to study, provided that they know enough English to follow lectures in this country.

Wherever possible, students should be familiar in India with the industry which they are sent here to study. In mining, this condition must in the future be enforced strictly, and no student be sent to the United Kingdom to study mining unless he has had at least a year's experience down an Indian mine.

The Local Governments should, in making selections, consult the business men and directors of industry in the province to a greater extent than appears to have been the practice hitherto. Business men are often likely to know of a promising lad who would make excellent use of a technical scholarship; they could also advise the Local Government as to the type of man whom the industries of the province need, and to whom they would readily offer employment.

Practical training in a business firm should be considered an integral part of the technical scholar's education, and consequently the period for which the scholarship is tenable should be extended so as to cover the time spent in undergoing such training.

A technical scholarship should not, except in rare cases, be tenable for more than five years, and in very few cases should it be granted for less than three; whatever duration is assigned to the scholarship it should be long enough to include a spell of continuous practical training. Wherever possible this training should be given in the United Kingdom.

The general effect of the recommendations will be to increase the cost to Government of the system of State technical scholarships. This additional expenditure will, however, be amply justified if in consequence of the changes the Committee proposes the men are better selected and better equipped for the work they have to do. Indeed, the expense of technical scholarships cannot be defended at all, says the report, unless they give the best preparation possible for the highest kind of industrial work. The ideal training for an industrial career is both lengthy and costly, and for this reason it should only be given, at public expense, to men of quite exceptional capacity. The average man, who can never be expected to do more than carry on well-known industries by well-known methods, can be trained in India; if he is trained in England it should be at private expense. But when the best men, so far as human foresight can discriminate, have been selected, it is false economy to give them any but the very best training.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The General Board of Studies will in the ensuing Michaelmas term proceed to appoint a University lecturer in surveying and cartography to hold office until September 30, 1916. Particulars of the stipend and duties of the lecturer can be obtained on application to the Vice-Chancellor. Candidates are requested to send their applications, with such testimonials as they think fit, to the Vice-Chancellor on or before October 11.

Mr. J. H. Burn, of Emmanuel College, has been elected into the Michael Foster research studentship.

The Royal Commissioners for the Exhibition of 1851 have, on the recommendation of the Vice-Chancellor, appointed Mr. I. Abrahamson, of Clare College, to an industrial bursary.

The Raymond Horton-Smith prize for 1913 is awarded to F. A. Roper and F. S. Scales, who are adjudged equal for theses for the degree of Doctor of Medicine. Subjects: "Creatinine and Creatin Metabolism, especially in Reference to Diabetes," and "The Electrocardiogram as an Aid to Diabetes." The M.D. degree committee expresses appreciation of the high standard attained by most of the theses submitted for the degree of Doctor of Medicine. Many of these theses, either records of clinical investigations on obscure diseases or of original laboratory research, ought, in the opinion of the committee, to be published. The theses submitted by Dr. A. Abrahams, on the analysis of nystagmus, Dr. H. T. Ashby, on the anæmias of infancy and childhood with special reference to the connection of iron with anæmia, Dr. A. F. MacCallan, on trachoma and Egyptian ophthalmias, and Dr. L. B. C. Trotter, on embolism and thrombosis of the mesenteric vessels, are adjudged worthy of special distinction. Amongst the theses not eligible to compete for the Raymond Horton-Smith prize that submitted by Dr. W. E. Hume, on a clinical and pathological study of the heart in diphtheria, attained a very high standard of merit.

LONDON.—Since the appointment of a full-time secretary, the work of the Appointments Board, constituted by the Senate to assist graduates and students of the University in obtaining appointments, and to coordinate and supplement the work done by the schools and institutions of the University in this direction, has increased to a very considerable extent. The secretary, Dr. A. D. Denning, will be pleased to give further information as to the Board, and to see graduates, at the central offices of the University, South Kensington, on Wednesday afternoons, 2 to 5, or Thursdays, 12 to 1.30, or at other times by arrangement. Approximately 1000 posts have been notified to suitably qualified graduates registered with the Board within the last three months and many appointments secured.

By the will of the Right Hon. Stuart, Baron Rendel, of Hatchlands, Guildford, who died on June 4, the sum of 5000*l.* is bequeathed to the University College of Wales, Aberystwith, of which he was president.

WE learn from *Science* that the General Education Board of the United States recently promised Washington and Jefferson College a grant of 20,000*l.* on condition that the college raised 80,000*l.* by June 30 last. On the date mentioned the college was able to announce that 88,000*l.* had been collected. Except for 10,000*l.*, which is to be expended on a physics department, the entire sum now at the disposal of the college is to be added to the general endowment fund.

THE organisation created by Lord Morley in 1909 for the benefit of Indian students included an Advisory Committee, and was mainly composed of influential Indian residents; fresh regulations have now been promulgated, we learn from *The Times*, giving the committee a definite constitution and specifying its functions. At least half of the committee are always to be Indian gentlemen resident in this country. The appointments are to be made by the Secretary of State for a term of three years. The functions of the committee are to keep itself informed as to the views of parents in India; to advise the Secretary of State; and to bring to his notice matters respecting the needs of the students. The committee has arranged to meet regularly on the first Monday in each month, and has appointed Sir M. M. Bhownaggree vice-chairman.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, July 28.—M. F. Guyon in the chair.—Maurice **Hamy**: Study of the nitrogen radiations. The explanation of the width of the lines of the spectrum of rarefied gases, based on the Doppler-Fizeau principle, has been recently verified experimentally by Buisson and Fabry working with Geissler tubes containing the rare gases of the atmosphere. Similar work on nitrogen, a gas furnishing a band spectrum, is now described by the author, and he concludes that the band spectrum of nitrogen obeys the same laws as line spectra, as regards the difference of path required to make interference bands disappear.—E. **Jungfleisch** and L. **Brunel**: The sulphur set at liberty in the action between sulphurous acid and water. A study of the condition in which the sulphur is deposited in this reaction. Five photographs accompany the paper.—Lucas **Championnière**: Operation for club foot by ablation of all the bones of the tarsus. Osseous regeneration in young subjects. The operation consists in the removal of all the tarsal bones with the exception of the posterior portion of the calcaneum. A description of the results in forty-two cases is given. In young children there is distinct regeneration of a portion of the bone removed.—Couyat **Barthoux** and H. **Douvillé**: The Jurassic in the desert to the east of the Isthmus of Suez.—P. **Duhem**: The formula for the velocity of sound. A correction of a formula recently published by M. Ariès.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the second quarter of 1913. Observations were possible on seventy-seven days, and the results are grouped in three tables showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—Rodolphe **Soreau**: An approximate formula for the arc of an ellipse.—E. **Stiemke**: Numbered moduli.—Kr. **Birkeland**: The conservation and the origin of terrestrial magnetism.—Georges **Claude**: The maintenance without difficulty of a temperature of −211° C. by the use of liquid nitrogen. A rapid stream of hydrogen, 20 to 25 litres per minute, previously cooled by flowing through a copper spiral immersed in liquid nitrogen, is passed through about 0·75 litre of liquid nitrogen contained in a capacious Dewar vessel. The temperature rapidly falls, and after about twenty minutes remains steady at −211° C., the melting point of nitrogen. At this point about two-thirds of the original liquid remains in the tube.—R. **Ladenburg** and F. **Reiche**: The absorption of coloured flames. It was shown more than thirty years ago by M. Gouy that the absorption of a coloured flame for the narrow lines of the spectrum which it emits is far from being complete, and that it was possible to calculate from his measurements the brightness of the lines as a function of the product of the thickness of the layer by the density of the metallic vapour. In the present paper these experimental results are compared with relations furnished by the electronic theory of dispersion. The two are shown to be in good agreement. If, on the other hand, the intensity of the lines is governed, not by the theory of dispersion, but by Rayleigh's theory according to the Doppler effect, then there is no agreement between the theory and Gouy's experiments.—E. **Briner**: The dissociation of the molecules into atoms considered as one of the factors of reaction velocity.—Victor **Henri** and René **Wurmser**: The negative photocatalysis of hydrogen peroxide. The stimulating or poisoning effect produced by certain substances on ferment actions has been hitherto ascribed to the action of the stimulant or poison on the ferment; the authors hold that this view must be modified in so far as this action may take place not on the ferment but on the body under transformation. In support of this view they adduce experiments on the photocatalysis of solutions of hydrogen peroxide in presence of traces of various substances, including sulphuric acid, caustic soda, iodine, potassium cyanide, &c. The addition of traces of these substances caused an increase of stability of the hydrogen peroxide towards ultra-violet rays.—F. **Bourion** and A. **Deshayes**: The quantitative separation of chromium and aluminium. The analysis of chromite. The method proposed is based on the use of a mixture of chlorine and sulphur chloride.—C. J. **Pitard**: Statistics and affinities of the flora of Chaouïa.—O. **Mengel**: The evolution of mildew according to the conditions of the medium.—Ch. **Julin** and A. **Robert**: *Ascidia fumigata*. Contribution to the study of the classification of the Phallusiideæ.—M. **Ruot**: *Bacillus lactis fermentens*, a spore forming butyleneglycol ferment of milk sugar. This organism produces an active fermentation of milk, 2 : 3-butyleneglycol accumulating in the culture, other products being carbon dioxide, hydrogen, acetylmethylcarbinol, acetic and formic acids.—Maurice **Renaud**: The irradiation of bacteria and the irradiated vaccines. For all the organisms studied irradiation with a quartz mercury-vapour lamp rendered the media sterile, leaving intact the histochemical properties. Irradiation prolonged beyond the period necessary for sterilisation does not diminish the activity of the soluble products of bacterial origin, such as toxins. The therapeutic application of irradiated cultures is discussed.—F. X. **Lesbre** and R. **Pécherot**: A calf born without the upper jawbone; a new Cyclocephalian type.—Eric **Gérard** and Hermann **Chauvin**: The waters of Spa. Radioactivity, electrical resistance, and cryoscopy.—J. **Ventre**: The influence of the yeasts on the variations of dry extract and of glycerol in wines.—L. **Lindet**: The soluble albuminoid matters of milk.—Ch. **Dhéré**: The diversity of hæmocyanines according to their zoological origin.

NEW SOUTH WALES.

Linnean Society, June 25.—Mr. W. S. Dun, president, in the chair.—C. **Hedley**: Studies on Australian Mollusca. Part xi. During 1912 the writer spent a furlough in Europe and America. Opportunities occurred for prosecuting conchological studies. Many types were examined, and much information was gathered from the Cumingian collection at the British Museum, the Lamarckian collection at Geneva, the collection of A. Angas at Newcastle, and that of Gould at Washington. Ten weeks were spent in constant study at the British Museum, during which almost the whole series of Australian marine gastropods and bivalves was examined. From these sources critical

notes on 160 species, mostly from East Australia, are presented, to which are added illustrations of thirty hitherto unfigured species. Numerous corrections of nomenclature are offered, both in restoring prior names, and in re-erecting species wrongly sunk in synonymy.—E. W. **Ferguson**: Revision of the Amycterides. Part ii., Talaurinus continued. In continuation of last year's paper, the species comprised in Sections B and C and groups vii.–xx., inclusive, are now dealt with. The types of all the species described by Macleay have been examined, as well as specimens compared with most of Pascoe's types.—T. G. **Sloane**: Descriptions of two new species of Cicindela from Western Australia. One of the two new species proposed is allied to *C. saetigera*, Horn, and is represented by specimens from Lake Austin, near Cue. The types of the other, which is allied to *C. tetragramma*, Chaud., were collected 100 miles north of Kalgoorlie.

BOOKS RECEIVED.

Meteorology in Mysore for 1911. Nineteenth Annual Report. By N. V. Iyengar. Pp. xiv+56+ charts. (Bangalore: Government Press.)

Forty-second Annual Report of the Local Government Board, 1912–13. Supplement in Continuation of the Report of the Medical Officer of the Board for 1912–13, containing a Second Report on Infant and Child Mortality, by the Medical Officer of the Board. Pp. vi+411. (London: H.M.S.O.; Wyman and Sons, Ltd.) 2*s*.

The Face and How to Read It. By A. I. Oppenheim. Pp. 188+plates. (London: F. L. Ballin.) 2*s*. 6*d*. net.

The Child and How to Train It. By A. I. Oppenheim. Pp. iii+171. (London: F. L. Ballin.) 2*s*. 6*d*. net.

Die Gründung und erste Entwicklung des deutschen Monistenbundes. By Dr. W. Breitenbach. Pp. 109. (Brackwede i.W.: Dr. W. Breitenbach.) 1 mark.

Practical Management of Pure Yeast: the Application and Examination of Brewery, Distillery, and Wine Yeasts. By A. Jörgensen. Translated by R. Grey. Second edition. Pp. 128. (London: *Brewing Trade Review*.) 5*s*. net.

Transactions of the Royal Society of Edinburgh. Vol. xlix., part 2 (No. 6). Caradocian Cystidea from Girvan. By Dr. F. A. Bather. Pp. 359–529+vi plates. (Edinburgh: R. Grant and Son.) 15*s*. 6*d*.

Twenty-eighth Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution, 1906–7. Pp. 308+103 plates. (Washington: Government Printing Office.)

Transactions and Proceedings of the Botanical Society of Edinburgh. Vol. xxvi., part 1. Pp. vii+100. (Edinburgh.)

Journal of the Royal Anthropological Institute of Great Britain and Ireland. Vol. xliii., 1913, January to June. (London: 50 Great Russell Street, W.C.) 15*s*. net.

Report on the Scientific Results of the *Michael Sars* North Atlantic Deep Sea Expedition, 1910, carried out under the Auspices of the Norwegian Government and the Superintendence of Sir John Murray and Dr. J. Hjort. Vol. iii., part 1. Zoology. (Bergen: Bergen Museum; J. Grieg.) 3*l*. 10*s*.

Experimental Science. I., Physics. By S. E. Brown. Pp. viii+272. (Cambridge University Press.) 3*s*. 6*d*.

A Galla-English, English-Galla Dictionary. Collected and compiled by E. C. Foot. Pp. vii+118. (Cambridge University Press.) 6*s*. net.

Proceedings of the Fifth International Congress of Mathematicians (Cambridge, 22–28 August, 1912). Edited by Profs. E. W. Hobson and A. E. H. Love. Vol. i. Pp. 500. Vol. ii. Pp. 657. (Cambridge University Press.) 2 vols., 30*s*. net.

The State Provision of Sanatoriums. By Dr. S. V. Pearson. Pp. viii+80+iv plans. (Cambridge University Press.) 3*s*. net.

Rafia Work. By H. C. Walker. Pp. 99. (London and Melbourne: Whitcombe and Tombs, Ltd.) 3*s*. net.

Who are the Maoris? By A. K. Newman. Pp. 303+plates. (London and Melbourne: Whitcombe and Tombs.) 7*s*. 6*d*. net.

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MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.
Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830